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ST. CLAIR RIVER POINT SOURCE SURVEY

1979 - 1980

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TABLE OF CONTENTS

		Page
PREFACE		i
EXECUTIVE SUMMARY		iii
ACKNOWLEDGEMENTS		iv
1.0	INTRODUCTION	1
2.0	OBJECTIVES	3
3.0	STUDY AREA	3
4.0	METHODS	6
	4.1 Sampling Programme	6
	4.1.1 Programme 1979	6
	4.1.2 Programme 1980	10
	4.2 St. Clair River Point Source Descriptions	11
	4.3 Sampling Procedures	11
	4.3.1 Containers	11
	4.3.2 Collection	13
	4.4 Organic Analyses	14
	4.4.1 Analytical Approach	14
	4.4.2 Quality Assurance	18
	4.4.3 Data Interpretation	19
	4.4.4 Limitations of Data	19
5.0	RESULTS	21
	5.1 1979 Sampling Programme	21
	5.2 1980 Sampling Programme	23
6.0	DICUSSION	62
	6.1 1979 Programme	62
	6.1.1 Related Studies	66
	6.2 1980 Programme	68
	6.2.1 Esso Chemical	68
	6.2.2 Dow Chemical	68
	6.2.3 Ethyl Corp	69
	6.2.4 Polysar	69
	6.2.5 Petrosar Treatment Plant	70
7.0	CONCLUSIONS	71
8.0	RECOMMENDATIONS	73
9.0	ABBREVIATIONS	75
10.0	REFERENCES	76
APPENDIX A - Samples Collected during 1979 and 1980		77
APPENDIX B - Detailed Point Source Descriptions		84
APPENDIX C - Organic Analysis Techniques		117
APPENDIX D - 1979 Organic Data		139
APPENDIX E - 1980 Organic Data		158
APPENDIX F - 1980 Discharge Flow Data		168
APPENDIX G - 1980 Conventional Chemical Data		171
APPENDIX H - Bioassay Test Data		193

PREFACE

The St. Clair River Point Source survey was a major organics survey undertaken jointly by the Ontario Ministry of the Environment and the Federal Environmental Protection Service during 1979-80.

Based on results of the 1977 St. Clair River Organic Study and this follow-up industrial sampling program in 1979-80, numerous process modifications and improvements in waste treatment facilities have been effected to to reduce inputs of organic contaminants from Sarnia-area industries. The Ministry and Environment Canada recognize the need to update the information on organic discharges and are currently involved in a three-year bi-national Upper Great Lakes Connecting Channels Study. This will involve more intensive effluent characterizations, and investigations of ambient water, sediment and biological conditions.

Sampling of municipal water supplies between Sarnia and Amherstburg was carried out by the Ministry's Southwestern Region in 1982 and 1983 when preliminary analytical results from this 1979-80 point source survey became available. The water supply survey revealed concentrations of organic compounds in finished water were generally low and presented no cause for concern in relation to available drinking water objectives and guidelines adopted in Ontario and elsewhere.

Recent and ongoing surveys carried out by the Ministry include assessments of water and sediment quality, biomonitoring studies using "clean" introduced clams to assess the bio-uptake of organic contaminants, contaminant levels in minnows and sport fish, and evaluations of the diversity of bottom fauna and contaminant levels in these benthic organisms. These biological assessments will be intensified as part of the Upper Great Lakes Connecting Channels Study.

The analytical results for this project became available during 1982 and 1983. Because of the preliminary nature of organics testing at the time, complexity of the analyses conducted, including laborious confirmatory steps, and the magnitude of the data base requiring evaluation, difficulties were encountered in bringing the project to completion. Sample collection, handling and storage protocols in 1979-80 were subsequently recognized to be inadequate to retain many of the volatile compounds that could be present, resulting in lower concentrations for these compounds or possibly a loss below the detection limit in some cases. Because of this problem and factors related to analytical precision, it was decided very early that a semi-quantitative format for presentation of the data would be necessary, accepting that the results for volatiles probably underestimate the levels of some contaminant discharges to the St. Clair River. Notwithstanding these limitations, it was felt that this report would provide a worthwhile basis for evaluating and implementing additional pollution controls and serving as baseline data for future surveys.

EXECUTIVE SUMMARY

A total of 235 samples were collected from industrial discharges, process sewers and service waters in the St. Clair River area over a two-year period and analyzed for 78 selected organic priority pollutants. Of these 78 organic priority pollutants, 74 were identified at least once during the study. The most frequently found compounds in final discharges were:

- Benzene
- Cis-1,3-dichloropropene *
- 2-Chloroethylvinylether *
- 1,1,2,2,-Tetrachloroethane
- Tetrachloroethylene *
- Bis(2-ethylhexyl) phthalate

These compounds were identified in more than 50% of the final discharges.

During 1980, four discharges were sampled continuously over extended periods of time. Very few compounds were consistently identified in any one discharge and the concentration levels of priority pollutants varied up to three orders of magnitude.

In order to evaluate whether a conventional treatment facility could reduce or remove hazardous organic pollutants, the Petrosar wastewate treatment system was continuously sampled for 9 days.

The treatment system did reduce the concentration of many compounds. Each component of the treatment system was effective in reducing different classes of organic compounds.

* Compounds not separated by G.C. methodology.

ACKNOWLEDGEMENTS

The support for this project was provided by the Ontario Ministry of the Environment (Water Resources Branch and Laboratory Services Branch), Environment Canada (Environmental Contaminants Contract Fund) and EPS Ontario Region (Great Lakes and Regular programmes).

Mr. Gordon Craig, Dr. R. Bonner, Mr. M. Riddle and Mr. V. Shantora assisted in the original study design. Mr. Ian Robertson, Jim Dochstader, Tom Wood, George Szober and John Scarterfield of the MOE Sarnia District Office assisted in site selection, scheduling and liaison with industry personnel. Without their support and enthusiasm this study could not have been undertaken.

Appreciation is extended to all industry and WPCP staff for their assistance during the sample collection. Technical support was provided by Mr. Ken Flood, Ms. M. Thompson, Mr. D. Robinson, Mr. B. Hallas, Dr. D. Fung, Mr. P. Lee and Mr. T. Pieper. Dr. R.C. Lao supervised the analyses conducted at the E.P.S. River Road Lab by Mr. R. Halman. Quality assurance data were provided by Ms. J. Lockwood and Mr. J. Coburn. The manuscript was typed by Mrs. M. Barclay, Ms. A-M Kearney, Ms. S. Hales and Ms. C. Camezuli.

The authors would also like to thank Ms. J. Pagel and Mr. F.C. Chen who provided constructive criticism and moral support during the writing of the report.

1.0 INTRODUCTION

With the ever-increasing number of organic compounds being identified in water, sediments and biota of the Great Lakes, attention has been focussed in recent years on the possible sources of these compounds. Most of these compounds are wastes and/or by-products of industrial processes. Recent surveys have concentrated on areas where high concentrations of industries are found such as the Niagara River, the Detroit River and the St. Clair River.

When oil was discovered at Oil Springs in Lambton County, Ontario in the late 1800's, the area was destined to become the heart of Canada's petrochemical industry. At the turn of the century, Eastern States Standard Oil (ESSO) purchased the Imperial Oil Company and built a new refinery on the banks of the St. Clair River at Sarnia. This became the focal point for further expansion and development of the Canadian petrochemical industry.

As the population of the area increased, the uses of the St. Clair River became more diversified. Uses such as public consumption, commercial fishing, recreation, industrial service water, cooling water and waste disposal posed conflicting demands upon the resource. Several studies have been conducted by the Ministry of the Environment (previously the Ontario Water Resources Commission) as well as by local industries and the Lambton Industrial Society (a cooperative group supported by local industries) which indicate that significant environmental improvement has occurred in the river with respect to heavy metal levels. Previous studies, however, have not included the wide range of organic compounds investigated in this study.

Historically, the evaluation of environmental contamination in rivers was based on the measurement of gross chemical parameters such as total organic carbon (TOC), biochemical oxygen demand (BOD), and total and suspended solids (TS and SS). These

parameters can indicate major changes in water quality but do not identify the chemicals responsible for that change. The growth in industrialization resulted in a much wider range of contaminants being discharged to rivers, especially organic compounds. Concurrent advances in analytical technology provided the capabilities to isolate, detect and measure these contaminants. These sophisticated analytical techniques, the most powerful being the combination of gas chromatography and mass spectrometry, has enabled scientists to measure trace concentrations (1µg/L) of organic compounds in water.

To date, a large number of organic chemicals have been identified in the Great Lakes. Analytical efforts have focussed on the most toxic of these chemicals and those which are used industrially with the greatest frequency.

Investigations by the Ontario Ministry of the Environment in 1975 (Sakuma, Meresz and Ma) and 1977-79 (Bonner and Meresz) identified a wide range of organic compounds in the final discharges of the various petrochemical-based industries along the St. Clair river. Both studies identified primarily volatile organic compounds.

In 1979, the Ontario Ministry of the Environment in cooperation with the Federal Environmental Protection Service embarked on a two-year study to survey most of the discharges to the St. Clair River. During this effort attention was given to a selected number (78) of organic compounds (volatile, acid and base/neutral extractable fractions) which had previously been identified by the U.S. E.P.A. as priority water pollutants. In addition to final discharges, service waters and several inplant process streams were also sampled. In the second year of the study, four discharges and one wastewater treatment facility were selected for intensive investigation. This report presents the results of the two-year study.

2.0 OBJECTIVES

The primary objectives of this study were:

1. To conduct an organic pollutant survey of the major point source discharges in the St. Clair River area to establish a baseline database against which to measure future improvements or deteriorations in water quality.

2. To determine concentration levels of organic compounds in four selected industrial discharges over an extended period of time (up to 42 days).

3. To determine if a selected conventional treatment system can effectively remove or significantly reduce the levels of these organic pollutants.

3.0 STUDY AREA

The St. Clair River flows from Lake Huron in the north to Lake St. Clair in the south, a distance of about 64 kilometres. A map of the river and its immediate surrounding area is given in Figure 1.

The daily flow of the river varies from 390 x 10^6 m^3 in the summer to 490 x 10^6 m^3 during runoff. Generally, the bottom profile is consistent with a deep central channel and shallow shelves close to the banks. The majority of the flow (90%) occurs in the main channel with the remaining flow divided along each shore (5%). The majority of discharges to the river take place in the shallow shoreline area. Figure 2 indicates relative locations of the various industries and sewage treatment plants sampled along the St. Clair River.

FIGURE 1. ST. CLAIR RIVER STUDY AREA

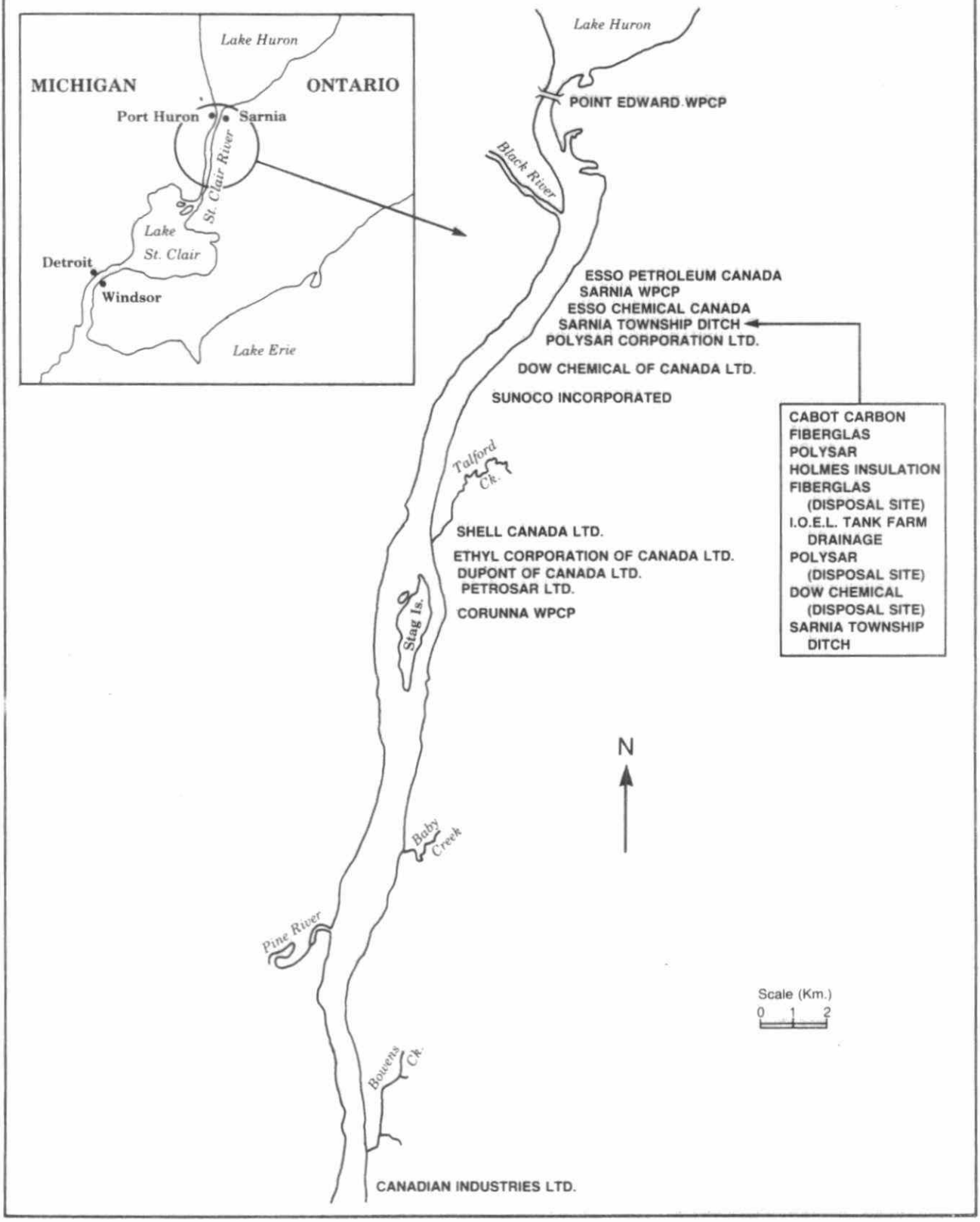
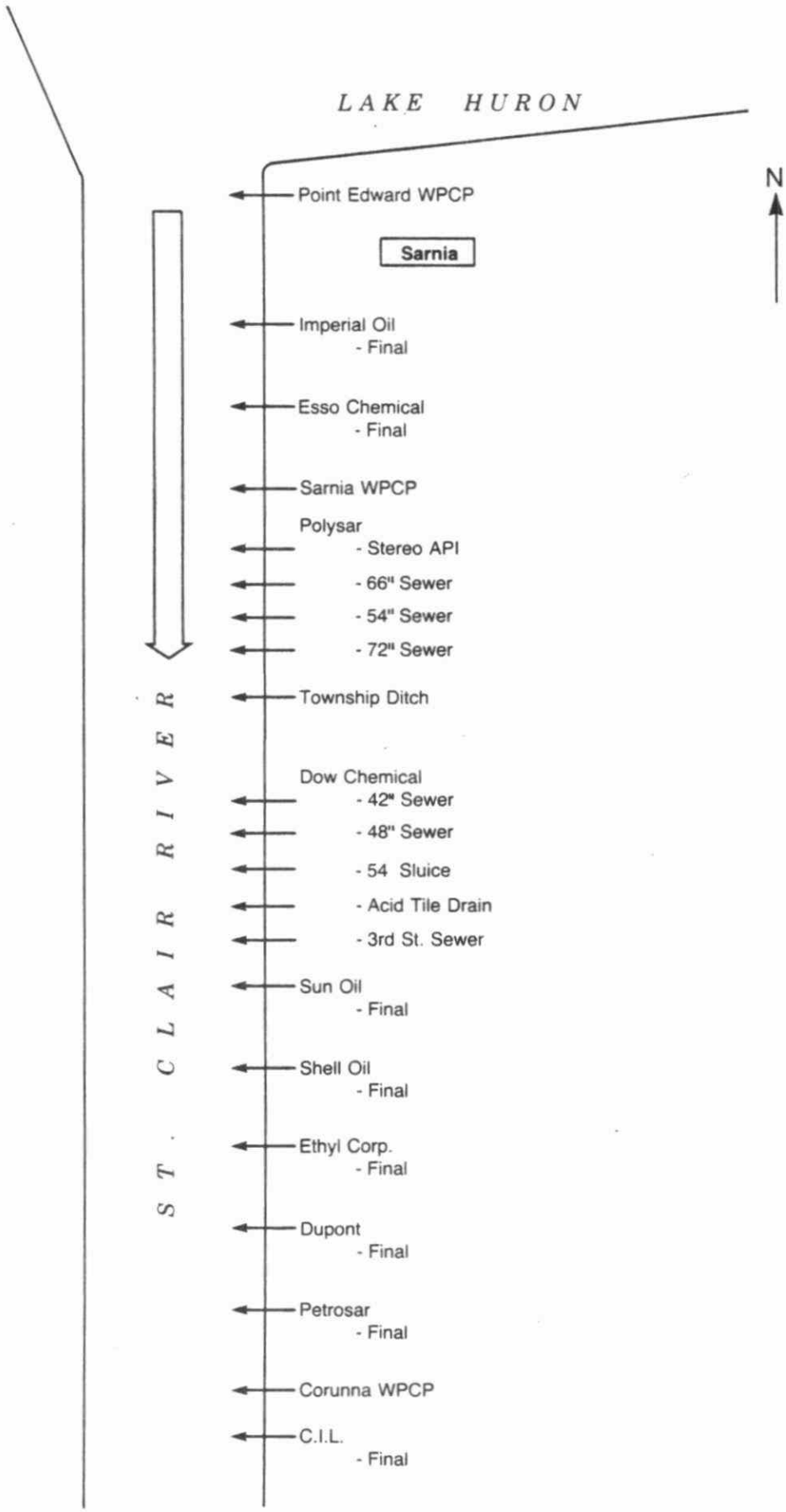


FIGURE 2: RELATIVE LOCATION OF FINAL EFFLUENT DISCHARGES TO ST. CLAIR RIVER



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4.0 METHODS

4.1 SAMPLING PROGRAMME

4.1.1 Programme 1979

The programme in 1979 was designed to sample the major industrial discharges and water pollution control plant (WPCP) wastes. These discharges were sampled at least three times during the summer. Collections were scheduled so that samples were taken on different week days and to ensure that the plants were operating under "normal conditions". Samples were not collected immediately before or after a scheduled shutdown or after abnormal plant operation.

A total of 143 samples were collected in 1979 from 13 companies, 3 water pollution control plants (WPCP) and at several locations along the Township Drainage Ditch. These included:

Sample	No. of Samples
Service Water	24
Final Discharges	66
Process/Inplant	36
Sewage Plants (WPCP)	3
Township Ditch	14
	143

The sample locations and number collected are summarized in Table 1. Sample number, location, date, type [service water (W), final discharge (F), process/inplant (P), and Township Ditch (D)] and sampling method [grab (G) or composite (C)] are given in Appendix A Table A1.

Table 1. Summary of the samples collected during 1979

Company	Sample Site	Number of Samples
C.I.L.	Final	3
	Service Water	3
Cabot Carbon	Final	1
Corunna WPCP	Final	1
Dow Chemical	3rd St. Sewer	3
	42" Sewer	4
	48" Sewer	3
	54" Sluice	3
	Acid Tile Drain	3
	Service Water	3
Dupont	Final	4
	Service Water	3
ESSO Chemical	A/C Filter	4
	Dual Media Filter	3
	Final	4
	Raw	3
Ethyl Corp.	Final	4
	Neutralization Pit	3

Table 1(cont.). Summary of the samples collected during 1979.

Company	Sample Site	Number of Samples
Fiberglas Canada	Disposal	2
	Final	1
Homes Insulation	Final	2
IOEL	Drainage	1
	Final	3
	Raw	3
	Service Water	3
Petrosar	A/C Filter	4
	Biox. Unit	4
	DAF	4
	Final	4
	Service Water	3
Pt. Edward WPCP	Final	1
Polysar Ltd.	54" Sewer	3
	66" Sewer	3
	72" Sewer	3
	Ditch In	2
	Ditch Out	3
	Service Water	3
	Stereo API	4
	Styrene II	2

Table 1(cont.). Summary of the samples collected during 1979.

Company	Sample Site	Number of Samples
Sarnia WPCP	Final	1
Shell Oil	Biox. Unit	1
	Cooling Water	1
	Final (Comp.)	2
	Service Water	3
Sun Oil	Final	4
	Raw	3
	Service Water	3
	Treated	3
Township Ditch	At RR Tracks	1
	SRD Above Fiberglas	2
	Scott Rd. Ditch	6

4.1.2 Programme 1980

The 1980 sampling programme was designed to monitor four final discharges and service waters, based on consecutive day samples composited for variable time periods. Discharges from Esso, Polysar, Dow and Ethyl were selected based on preliminary data from the 1979 samples and consultation with the MOE District Office. Again the schedule was established after consultation with each company so that the sampling period did not cover any routine shutdowns or major change in processes.

Sampling at ESSO Chemical (service water and final) and Dow Chemical (service water and Third Street Sewer) were for 30 consecutive days. These daily composites were combined into six 5-day composites for each sample site. The Polysar service water, Ditch In and Ditch Out were sampled for 20 consecutive days. These daily composites were combined to give four 5-day composites for each site. Ethyl Corporation's service water and final discharge were sampled continuously for 42 days. These samples were combined to give six 7-day composites for each sampling location. These samples were analyzed for volatiles as well as the base/neutral and acid fractions.

The Petrosar wastewater treatment facility was selected for detailed evaluation of efficiency for removal of organic compounds. The treatment plant was sampled at four locations:

-discharge from the Oily dissolved air floatation (DAF)
-Chemical DAF
-Biox Unit
-A/C Filter

Daily composte samples were obtained over nine consecutive days which were analyzed individually. During the nine-day sampling period the service water was sampled three times (24 h composite) and the final discharge sampled five times (24 h composite). The sample locations and number of samples collected are summarized in Table 2.

Sample number, location, date, sample type and method of sampling are listed in Appendix A Table A2.

4.2 ST. CLAIR RIVER POINT SOURCE DESCRIPTIONS

The industrial and municipal descriptions and schematics are presented in Appendix B and are current to 1979 or 1980 where applicable. Where significant changes have since been made to product lines and/or wastewater treatment systems, these changes are noted and are current to 1985. The municipal water pollution control plant (WPCP) descriptions include the plant capacity, type or treatment and historical data for the removal of BOD_5, SS and phosphorus. The industrial descriptions are limited to a listing of the product line and details of the wastewater treatment systems in place at the time of the 1979/80 surveys. Sampling locations and dates are indicated and are shown on the site schematics.

4.3 SAMPLING PROCEDURES

4.3.1 Containers

Sample containers used were 2.5 litre glass bottles with teflon-lined caps. Samples were refrigerated immediately after collection and stored at 3°C. They were transported to Toronto weekly in ince-packed coolers and stored at 3°C until extraction.

Table 2. Summary of the samples collected during 1980.

Company	Sample Site	Number of Samples
Dow Chemical	3rd St. Sewer	6
	Service Water	6
ESSO Chemical	Final	6
	Service Water	6
Ethyl Corporation	Final	6
	Service Water	6
Petrosar	A/C Filter	9
	Biox. Unit	9
	Chemical DAF	9
	Final	5
	Oily DAF	9
	Service Water	3
Polysar Corporation	Ditch In	4
	Ditch Out	4
	Service	4

All equipment was acetone-washed and dried in order to avoid contamination. Only glass, teflon or stainless steel materials were used except where noted. Sample bottles were cleaned with soap, rinsed, acetone-washed (acetone distilled in glass) and dried in a fume hood for 24 hours. Sample bottles were triple-rinsed with the sample prior to filling. All bottles were filled so that there was no air space in the bottle.

4.3.2 Collection

Grab samples were collected directly into a sample bottle or in an acetone-washed, stainless steel beaker rinsed with distilled water.

Composite samples were collected using a continuous flow peristaltic pump connected by teflon tubing to the pump head and from the pump head to the sample bottle. A short length (10 cm) of rinsed tygon tubing was used in the pump head. At Polysar, composite samples were taken directly from the company's composite sampler.

Samples collected in 1980 for conventional chemical analysis (phenols, total solids, suspended solids, dissolved solids, dissolved organic carbon, dissolved inorganic carbon and particulate carbon) were taken from the composite sample and stored in nalgene bottles until analyzed. Phenol samples were collected in 250 mL bottles and $CuSO_4$ preservative was added. No samples were collected for conventional chemical analysis during the 1979 programme.

All conventional chemical analyses were conducted at the MOE laboratory in Rexdale according to the standard methods described in "Handbook of Analytical Methods".

4.4 ORGANIC ANALYSES

4.4.1 Analytical Approach

The parameters to be analysed in this study were a group of seventy eighty priority pollutants including volatile organics, basic/neutral and acidic extractable organics. These compounds are listed in Table 3.

The analytical approach used in the measurement of these trace organic components incorporated, as a first step, a sample concentration procedure. This involved a purge and trap concentration of volatile organics and a liquid/liquid extraction of extractable organics. The individual fractions were then analysed by packed column gas chromatography with detection by a flame ionization detector (FID) in conjunction with an electron capture detector (ECD) where appropriate. Full details of the methodology employed are given in Appendix C.

Potential interferences encountered when analysing these complex samples by packed column gas chromatography were responsible for the presentation of data in a semi-quantitative manner. This approach was the state-of-the-art at the time of the initiation of the study in 1979. The use of low resolution packed columns has since been superceded by the routine application of high resolution capillary columns for such analyses.

Some of the extracts investigated were extremely complex in that they included a "hydrocarbon envelope" which interfered with many of the analytes. The hydrocarbons observed are not unexpected in effluents from the petrochemical industry, since they are derived from petroleum fractions such as fuel oil. Supplementary clean-up techniques were necessary for the analysis of such samples.

Table 3. Organic compounds analysed.

VOLATILES

- * Methylene chloride
- Trichlorofluoromethane
- 1,1-Dichloroethylene
- 1,1-Dichloroethane
- Trans-1,2-dichloroethylene
- Chloroform
- 1,2-Dichloroethane
- 1,1,1-Trichloroethane
- * Carbontetrachloride
- Dichlorobromomethane) *
- Bis(2-chloromethyl)ether)
- 1,2-Dichloropropane
- Trans-1,3-dichloropropylene
- * Trichloroethylene)
- Chlorodibromomethane)*
- 1,1,2-Trichloroethane)
- Cis-1,3-dichloropropene)
- * Benzene)*
- 2-Chloroethylvinylether)
- Bromoform
- 1,1,2,2-Tetrachloroethane)*
- * Tetrachloroethylene)
- * Toluene
- Chlorobenzene
- * Ethylbenzene

Base/Neutral Extractables

1,3-Dichlorobenzene
1 4-Dichlorobenzene
Hexachloroethane
1,2-Dichlorobenzene
Bis(2-chloroisopropyl)ether
Nitrobenzene
N-Nitroso-di-n-propylamine
Bis(2-chloroethoxy)methane
Hexachlorobutadiene
1,2,4-Trichlorobenzene
Naphthalene
2-Chloronaphthalene
Acenaphthylene
Acenaphthene
Dimethyl phthalate
2,6-Dinitrotoluene
Fluorene)*
4-Chlorophenyl phenyl ether)
Diethyl phthalate)*
2,4-Dinitrotoluene)
1,2-Diphenylhydrazine
N-Nitrosodiphenylamine)
Hexachlorobenzene) *
4-Bromophenyl phenyl ether)
Phenanthrene) *
Anthracene)
Di-n-butyl phthalate
Fluoranthene
Pyrene
Benzidine
Butyl benzyl phthalate
Bis(2-ethylhexyl)phthalate
Chrysene
Benz(a)anthracene
3,3¹-Dichlorobenzidine
Di-n-octyl phthalate

Table 3(cont.). Organic compounds analysed.

Benzo(b)fluoranthene) *
Benzo(k)fluoranthene)
Benzo(a)pyrene
Indeno(1,2,3-c,d)pyrene) *
Dibenzo(a,h)anthracene)
Benzo(g,h,i)perylene

Acid Extractables

Phenol
2-Chlorophenol
2,4-Dimethylphenol)*
2-Nitrophenol)
2,4-Dichlorophenol
p-Chloro-m-cresol
2,4,6-Trichlorophenol
2,4-Dinitrophenol
4-Nitrophenol
4,6-Dinitro-o-cresol
Pentachlorophenol

* compounds not separated by GC methodology.

4.4.2 Quality Assurance

The confirmation of approximately 5% of samples by gas chromatography/mass spectrometry (GC/MS) was originally planned for quality assurance purposes. Owing to the complexity of the samples, additional GC/MS confirmation was found to be required in order to improve data quality.

Confirmation of GC/MS was carried out on a total of 16% of individual fractions over the 2 year sampling period. Of the 145 samples analysed in the 1979 sampling, 36% had one or more fractions submitted for GC/MS confirmation while in 1980, 46% of samples were submitted for GC/MS confirmation of at least one fraction. The following Table indicates the percentage of fractions confirmed by GC/MS for each study year.

TABLE 4

Percentage of fractions confirmed by GC/MS for each study year.

	Fraction		
Study Year	Base/Neutrals	Acids	Volatiles
1979	32	2	5
1980	39	13	11

The choice of fractions to be analysed by GC/MS was governed by the large number of samples which required confirmational analysis.

Additional details of the quality control program are included in Appendix C.

4.4.3 Data Interpretation

Potential interferences encountered when analysing complex samples by packed column gas chromatography resulted in a decision to present the data on a semi-quantitative basis rather than in the quantitative manner initially planned for the study. The semi-quantitative approach enables some compensation to be made for the possibility of interferences affecting the quantification of a particular component. The concentration range categories used throughout this report are:

A 1-10 ug/L
B 10-100 ug/L
C 100-1000 ug/L
D 1-10 mg/L
E 10-100 mg/L
F 100-1000 mg/L

* peak identified by GC but not confirmed by GC/MS analysis

\- peak identified by GC but not confirmed by GC/MS analysis of samples from related sites

The detailed guidelines used in the semi-quantitative interpretation of the data are presented in Appendix C.

4.4.4 Limitations of Data

The data presented in this report constitutes the first attempt to develop a data base for complex industrial organic discharges to the St. Clair River.

Several aspects of this study need to be considered prior to the use of any of the data generated.

1. The number of samples collected from any one location was limited. The typical variation in composition of each discharge may not be covered by the sampling programme as set up.

2. Some of the samples were taken as composites over a period of time. This technique, while accounting for within-day (for a 24 hour composite) or day-to-day (for a multi-day composite) variation, probably will lead to some losses of the volatile organics present.

3. The data set presented in this study is a semi-quantitative one based primarily on packed column GC analysis with detection by FID or by combined FID/ECD. Many of the data sub-sets have been confirmed by the application of GC/MS and these confirmations extrapolated to associated discharges.

   In light of the semi-quantitative nature of the data and the limited sampling frequency, it is recommended that these data not be used in mass loading calculations.

5.0 RESULTS

The organic analysis results for the 143 samples collected in 1979 are presented in Appendix D Tables D1-D13. Appendix E, Tables E1-E9 present the organic results for the 92 samples collected in 1980.

Tables 5 and 6 summarize the number of compounds identified in each concentration range and at levels > 1µg/L, > 10µg/L and > 1 mg/L, for each sample for 1979 and 1980 respectively. Totals for the number of compounds identified at greater than 1 µg/L, the number found at greater than 10 µg/L and the number found at greater than 1 mg/L are also given.

During 1980, flow rates were recorded during the sampling period for Polysar Ditch In and Ditch Out as well as seven locations within the Petrosar treatment system. These results are summarized in Appendix F.

The conventional chemical parameters measured phenols, total solids, suspended solids, dissolved solids, dissolved organic carbon, dissolved inorganic carbon and particulate carbon on the 1980 daily composite samples, as well as the "weekly" composite samples, are summarized in Appendix G.

5.1.0 1979 Sampling Programme

The compounds most frequently found in all final discharges (including those discharging to the Township Ditch system) were:

Cis-1,3-dichloropropene)

Benzene)*

2-Chloroethylvinylether)

1,1,2,2-Tetrachloroethane)

Tetrachloroethylene)*

Bis(2-ethylhexyl) phthalate

*compounds not separated by GC methodology

These compounds were found in more than 50% of the final discharges (69 samples) in 1979 with the benzene/Cis-1,3-dichloropropene/2-chloroethylvinylether peak and bis(2-ethylhexyl) phthalate identified more than 60% of the time.

When considering only the discharges to the St. Clair River, including the Township Ditch but excluding the individual discharges to the Township Ditch, the same three compounds or groups of compounds were identified in over 50% of the samples. In both cases the median concentration range was the same (Tables 7-10).

Although these compounds were identified frequently they were generally less than 100 µg/L.

Many compounds found less frequently were identified at higher concentrations, although less than 1 mg/L, in most cases. There were only 12 measurements of compounds greater than 1mg/L in the final discharges. Seven of these were in the Fiberglas Disposal discharge to the Township Ditch system. Subsequent to this survey the site has been capped and there is no discharge to the Township Ditch system (Appendix B 1.11).

Process streams and inplant samples generally had more organic compounds at higher concentration ranges than the corresponding final discharges. This would be attributable to on-stream treatment plants as well as, in some cases, the addition of cooling water or less contaminated waste streams to the final discharges immediately before discharge.

Although a large number of compounds (primarily volatiles) were identified in the service waters during 1979, most were at levels of ≤ 10 µg/L range during the sampling programme.

Of the three WPCPs sampled, Pt. Edward had the highest number of organic compounds at 42, while the Corunna and Sarnia plants had 23 and 20, respectively.

During the 1979 sampling programme, all but four compounds or groups of compounds were identified. The only compounds not identified were:

1. N-Nitroso-di-n-propylamine
2. Bis(2-chlorethoxy)methane
3. Benzidine
4. 3,3¹-Dichlorobenzidine

5.2.0 1980 Sampling Programme

In contrast to the 1979 survey, the 1980 programme concentrated on fewer discharges samples more frequently.

Five discharges were monitored continuously for 20 to 42 days. The following numbers of compounds or groups of compounds were identified in these final discharges:

Company	No. of Compounds or groups
Esso Chemical - Final	4
Dow - 3rd St. Sewer	17
Polysar - Ditch Out*	8
Ethyl Corp. - Final	4
Petrosar - Final	21

*Adjusted for compounds identified in Ditch In samples

The Petrosar treatment facility was sampled at 4 locations for 9 consecutive days.

Tables 11-30 summarize the frequency and concentration ranges at which the compounds were identified.

Table 5 Summary of the number of compounds identified in each concentration range for all samples (143) during 1979.

Sample			Concentration Range								
#	Site	Date	A	B	C	D	E	F	>1 ug/L	>10 ug/L	>1 mg/L
C.I.L.											
61	Final	July 26	5	1	0	0	0	0	6	1	0
113	Final	Aug. 23	3	0	0	0	0	0	3	0	0
120	Final	Aug. 28	2	0	0	0	0	0	2	0	0
60	Service Water	July 26	5	0	0	0	0	0	5	0	0
112	Service Water	Aug. 23	6	0	0	0	0	0	6	0	0
119	Service Water	Aug. 28	2	1	0	0	0	0	3	1	0
Cabot Carbon											
139	Final	Aug. 30	3	0	0	0	0	0	3	0	0
Corunna WPCP											
105	Final	Aug. 22	5	0	0	0	0	0	5	0	0
Dow Chemical											
24	3rd St. Sewer	June 20	3	4	0	0	0	0	7	4	0
46	3rd St. Sewer	July 18	1	0	0	0	0	0	1	0	0
91	3rd St. Sewer	Aug. 15	4	0	0	0	0	0	4	0	0
20	42" Sewer	June 20	2	6	2	0	0	0	10	8	0
42	42" Sewer	July 18	5	7	1	0	0	0	13	8	0
88	42" Sewer	Aug. 15	8	7	2	0	0	0	17	9	0
140	42" Sewer	Sept. 5	7	5	1	0	0	0	13	6	0
21	48" Sewer	June 20	9	4	0	0	0	0	13	4	0
43	48" Sewer	July 18	2	7	0	0	0	0	9	7	0
89	48" Sewer	Aug. 15	6	6	0	0	0	0	12	6	0
90	54" Sluice	Aug. 15	7	1	0	0	0	0	8	1	0
22	54" Sluice	June 20	9	1	0	0	0	0	10	1	0
44	54" Sluice	July 18	9	4	0	0	0	0	13	4	0
23	Acid Tile Drain	June 20	2	2	8	2	0	0	14	12	2
45	Acid Tile Drain	July 18	5	11	4	0	0	0	20	15	0
87	Acid Tile Drain	Aug. 15	11	11	4	0	1	0	27	16	1
19	Service Water	June 20	7	0	0	0	0	0	7	0	0
41	Service Water	July 18	4	0	0	0	0	0	4	0	0
86	Service Water	Aug. 15	6	0	0	0	0	0	6	0	0

Table 5(cont.). Summary of the number of compounds identified in each concentration range for all samples (143) during 1979.

Sample #	Site	Date	Concentration Range A	B	C	D	E	F	>1 ug/L	>10 ug/L	>1 mg/L
Dupont											
48	Final	July 24	2	2	0	0	0	0	4	2	0
115	Final	Aug. 23	6	0	0	0	0	0	6	0	0
122	Final	Aug. 28	2	0	0	0	0	0	2	0	0
137	Final	Aug. 30	5	1	0	0	0	0	6	1	0
47	Service Water	July 24	2	2	0	0	0	0	4	2	0
114	Service Water	Aug. 23	9	1	0	0	0	0	10	1	0
121	Service Water	Aug. 28	7	0	0	0	0	0	7	0	0
ESSO Chemical											
57	A/C Filter	July 25	8	0	1	1	0	0	10	2	1
77	A/C Filter	Aug. 2	6	2	1	0	1	0	11	4	1
108	A/C Filter	Aug. 22	4	5	9	0	1	1	20	16	2
155	A/C Filter	Oct. 24	3	9	1	1	1	0	15	12	2
76	Dual Media Filter	Aug. 2	2	4	6	3	0	0	15	13	3
107	Dual Media Filter	Aug. 22	5	3	5	0	2	0	15	10	2
154	Dual Media Filter	Oct. 24	5	11	3	0	0	0	19	14	0
58	Final	July 25	6	7	2	0	0	0	15	9	0
78	Final	Aug. 2	3	3	3	0	0	0	9	6	0
109	Final	Aug. 22	4	8	4	0	0	0	16	12	0
156	Final	Oct. 24	10	3	0	0	0	0	13	3	0
75	Raw	Aug. 2	6	7	1	0	0	0	14	8	0
106	Raw	Aug. 22	12	4	0	0	2	0	18	6	2
153	Raw	Oct. 24	10	10	2	2	1	0	25	15	3
Ethyl Corp.											
68	Final	July 31	3	0	0	1	0	0	4	1	1
99	Final	Aug. 21	6	2	1	0	0	0	10	4	0
118	Final	Aug. 27	9	2	1	0	0	0	12	3	0
152	Final	Oct. 24	3	3	0	0	0	0	6	3	0
67	Neutralization Pit	July 31	7	3	1	0	0	0	11	4	0
100	Neutralization Pit	Aug. 21	9	9	1	0	0	0	19	10	0
117	Neutralization Pit	Aug. 27	5	0	0	1	0	0	6	1	0

Table 5(cont.). Summary of the number of compounds identified in each concentration range for all samples (143) during 1979.

Sample			Concentration Range								
#	Site	Date	A	B	C	D	E	F	>1 ug/L	>10 ug/L	>1 mg/L
Fiberglas Canada											
128	Disposal	Aug. 29	5	16	5	4	0	0	30	25	4
146	Disposal	Sept. 5	8	12	3	3	0	0	25	17	3
138	Final	Aug. 30	3	0	0	0	0	0	3	0	0
Holmes Insulation											
130	Final	Aug. 29	4	2	0	0	0	0	6	2	0
144	Final	Sept. 5	9	0	0	0	0	0	9	0	0
IOEL											
126	Drainage	Aug. 29	8	3	0	0	0	0	11	3	0
74	Final	Aug. 2	8	3	0	0	0	0	11	3	0
59	Final (Comp.)	July 25	2	1	0	0	0	0	3	1	0
103	Final (Comp.)	Aug. 21	2	0	0	0	0	0	2	0	0
55	Raw	July 25	10	10	3	2	0	0	25	15	2
73	Raw	Aug. 2	5	10	3	1	0	0	19	14	1
102	Raw	Aug. 21	7	8	7	1	0	0	23	16	1
54	Service Water	July 25	1	1	0	0	0	0	2	1	0
72	Service Water	Aug. 2	0	0	0	0	0	0	0	0	0
101	Service Water	Aug. 21	1	0	0	0	0	0	1	0	0
Petrosar											
52	A/C Filter	July 25	5	8	2	0	0	0	15	10	0
65	A/C Filter	July 31	1	4	4	2	0	0	11	10	2
135	A/C Filter	Aug. 29	10	3	1	1	0	0	15	5	1
160	A/C Filter	Oct. 29	7	11	2	0	0	0	20	13	0
51	Biox. Unit	July 25	7	3	0	0	1	0	11	4	1
64	Biox. Unit	July 31	3	1	0	0	0	0	4	1	0
136	Biox. Unit	Aug. 29	4	8	1	0	0	0	13	9	0
159	Biox. Unit	Oct. 29	9	7	0	0	0	0	16	7	0
50	DAF	July 25	0	6	8	3	3	0	21	18	6
63	DAF	July 31	1	9	4	3	1	0	18	17	4
134	DAF	Aug. 29	3	7	7	3	1	0	21	18	4
158	DAF	Oct. 29	1	4	11	2	3	0	21	20	5
53	Final	July 25	9	7	0	0	0	0	16	7	0

Table 5(cont.). Summary of the number of compounds identified in each concentration range for all samples (143) during 1979.

Sample #	Site	Date	Concentration Range A	B	C	D	E	F	>1 ug/L	>10 ug/L	>1 mg/L
Petrosar (cont.)											
66	Final	July 31	14	6	0	0	0	0	20	6	0
133	Final	Aug. 29	9	0	0	0	0	0	9	0	0
161	Final	Oct. 29	12	3	1	0	0	0	16	4	0
49	Service Water	July 25	4	1	0	0	0	0	5	1	0
62	Service Water	July 31	4	2	0	0	0	0	6	2	0
132	Service Water	Aug. 29	5	0	0	0	0	0	5	0	0
Pt. Edward WPCP											
104	Final	Aug. 22	12	18	4	0	0	0	34	22	0
Polysar Ltd											
4	54" Sewer	June 12	5	2	0	0	0	0	7	2	0
32	54" Sewer	June 27	3	1	0	0	0	0	4	1	0
83	54" Sewer	Aug. 2	11	2	0	0	0	0	13	2	0
3	66" Sewer	June 12	4	3	0	0	0	0	7	3	0
31	66" Sewer	June 27	4	1	0	0	0	0	5	1	0
81	66" Sewer	Aug. 2	1	0	0	0	0	0	1	0	0
5	72" Sewer	June 12	4	1	0	0	0	0	5	1	0
33	72" Sewer	June 27	2	0	0	0	0	0	2	0	0
82	72" Sewer	Aug. 2	1	1	0	0	0	0	2	1	0
34	Ditch In	June 27	8	0	0	0	0	0	8	0	0
84	Ditch In	Aug. 2	17	2	0	0	0	0	19	2	0
7	Ditch Out	June 12	5	1	0	0	0	0	6	1	0
35	Ditch Out	June 27	4	3	0	0	0	0	7	3	0
85	Ditch Out	Aug. 2	7	3	0	0	0	0	10	3	0
1	Service Water	June 12	3	0	0	0	0	0	3	0	0
29	Service Water	June 27	3	0	1	0	0	0	4	1	0
79	Service Water	Aug. 2	4	1	0	0	0	0	5	1	0
2	Stereo API	June 12	3	2	0	0	0	0	5	2	0
30	Stereo API	June 27	3	1	0	0	0	0	4	1	0
80	Stereo API	Aug. 2	2	3	0	0	0	0	5	3	0
94	Stereo API	Aug. 16	2	1	0	0	1	0	4	2	1
93	Styrene II	Aug. 16	9	1	2	0	0	0	12	3	0
116	Styrene II	Aug. 24	15	4	0	0	1	0	20	5	1

Table 5(cont.). Summary of the number of compounds identified in each concentration range for all samples (143) during 1979.

Sample #	Site	Date	Concentration Range A	B	C	D	E	F	>1 ug/L	>10 ug/L	>1 mg/L
Sarnia WPCP											
143	Final	Sept. 5	6	2	0	0	0	0	8	2	0
Shell Oil											
70	Biox. Unit	Aug. 1	8	14	0	0	0	0	22	14	0
70a	Cooling Water	Aug. 1	6	1	0	0	0	0	7	1	0
111	Final (Comp.)	Aug. 23	6	0	0	0	0	0	6	0	0
124	Final (Comp.)	Aug. 29	3	1	0	0	0	0	4	1	0
69	Service Water	Aug. 1	3	1	0	0	0	0	4	1	0
110	Service Water	Aug. 23	6	0	0	0	0	0	6	0	0
123	Service Water	Aug. 29	3	1	0	0	0	0	4	1	0
Sun Oil											
28	Final	June 21	8	2	1	0	0	0	11	3	0
38	Final	July 17	7	1	0	0	0	0	8	1	0
96	Final	Aug. 16	8	1	0	0	0	0	9	1	0
157	Final	Oct. 29	8	0	8	0	0	0	16	8	0
26	Raw	June 21	9	8	5	3	0	0	25	16	3
39	Raw	July 17	6	9	4	0	0	0	19	13	0
97	Raw	Aug. 16	8	9	5	1	0	0	23	15	1
25	Service Water	June 21	1	1	0	0	0	0	2	1	0
37	Service Water	July 17	8	1	0	0	0	0	9	1	0
95	Service Water	Aug. 16	7	1	0	0	0	0	8	1	0
27	Treated	June 21	11	3	1	0	0	0	15	3	0
40	Treated	July 17	6	7	1	0	0	0	14	8	0
98	Treated	Aug. 16	8	6	2	0	0	0	16	8	0

Table 5(cont.). Summary of the number of compounds identified in each concentration range for all samples (143) during 1979.

Sample #	Site	Date	Concentration Range A	B	C	D	E	F	>1 ug/L	>10 ug/L	>1 mg/L
Township Ditch											
131	At RR Tracks	Aug. 29	2	4	1	0	0	0	7	5	0
129	SRD Above Fiberglas	Aug. 29	7	1	1	0	0	0	9	2	0
145	SRD Above Fiberglas	Sept. 5	8	1	0	0	0	0	9	1	0
9	Scott Rd. Ditch	June 14	2	10	6	0	0	0	18	16	0
36	Scott Rd. Ditch	June 27	5	6	2	0	0	0	13	8	0
125	Scott Rd. Ditch 1000	Aug. 29	6	5	0	0	0	0	11	5	0
127	Scott Rd. Ditch 1030	Aug. 29	5	4	2	0	0	0	11	6	0
147	Scott Rd. Ditch 1700	Sept. 5	7	3	0	0	0	0	10	3	0
148	Scott Rd. Ditch 1730	Sept. 5	10	1	1	0	0	0	12	2	0

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
3. acid fraction analyzed by GC/MS
4. concentration ranges:
   - A = 1 - 10 ug/L
   - B = 10 - 100 ug/L
   - C = 100 - 1000 ug/L (1000 ug/L = 1 mg/L)
   - D = 1 - 10 mg/L
   - E = 10 - 100 mg/L
   - F = 100 - 1000 mg/L
   - * = peak identified by GC but not confirmed by GC/MS analysis
   - - = peak identified by GC but not confirmed by GC/MS analysis of samples from related sites
5. + = compounds not separated by GC methodology

Table 6. Summary of number of compounds identified in each concentration range for all samples (92) during 1980.

Sample			Concentration Range								
#	Site	Date	A	B	C	D	E	F	>1 ug/L	>10 ug/L	>1 mg/L
Dow Chemical											
E20	3rd St. Sewer	Aug. 6-10	5	2	1	0	0	0	8	3	0
E21	3rd St. Sewer	Aug. 11-15	6	3	0	0	0	0	9	3	0
E22	3rd St. Sewer	Aug. 16-20	6	5	0	0	0	0	11	5	0
E40	3rd St. Sewer	Aug. 21-25	10	2	1	0	0	0	13	3	0
E41	3rd St. Sewer	Aug. 26-30	9	0	2	0	0	0	11	2	0
E42	3rd St. Sewer	Aug. 31 - Sept. 4	10	2	1	0	0	0	13	3	0
E17	Service Water	Aug. 6-10	6	3	0	0	0	0	9	3	0
E18	Service Water	Aug. 11-15	5	4	1	0	0	0	10	5	0
E19	Service Water	Aug. 16-20	1	0	0	0	0	0	1	0	0
E37	Service Water	Aug. 21-25	6	0	0	0	0	0	6	0	0
E38	Service Water	Aug. 26-30	5	0	0	0	0	0	5	0	0
E39	Service Water	Aug. 31 - Sept. 4	5	4	0	0	0	0	9	4	0
Esso Chemical											
E9	Final	July 29 - Aug. 2	2	1	0	0	0	0	3	1	0
E10	Final	Aug. 3-7	0	0	0	0	0	0	0	0	0
E14	Final	Aug. 8-12	4	0	0	0	0	0	4	0	0
E15	Final	Aug. 13-17	2	0	0	0	0	0	2	0	0
E16	Final	Aug. 18-22	1	0	0	0	0	0	1	0	0
E36	Final	Aug. 23-27	1	0	0	0	0	0	1	0	0
E7	Service Water	July 29 - Aug. 2	3	1	0	0	0	0	4	1	0
E8	Service Water	Aug. 3-7	0	0	0	0	0	0	0	0	0
E11	Service Water	Aug. 8-12	0	0	0	0	0	0	0	0	0
E12	Service Water	Aug. 13-17	0	0	0	0	0	0	0	0	0
E13	Service Water	Aug. 18-22	0	0	0	0	0	0	0	0	0
E35	Service Water	Aug. 23-27	0	0	0	0	0	0	0	0	0
Ethyl Corporation											
E3	Final	July 16-22	0	0	0	1	0	0	1	1	1
E4	Final	July 23-29	1	0	0	0	0	0	1	0	0
E5	Final	July 30 - Aug. 5	0	0	0	0	0	0	0	0	0
E31	Final	Aug. 6-12	0	1	0	0	0	0	1	1	0
E32	Final	Aug. 13-19	3	0	0	0	0	0	3	0	0
E34	Final	Aug. 20-26	1	0	0	0	0	0	1	0	0
E1	Service Water	July 16-22	3	0	0	0	0	0	3	0	0
E2	Service Water	July 23-29	5	0	0	0	0	0	5	0	0
E6	Service Water	July 30 - Aug. 5	4	0	0	0	0	0	4	0	0
E29	Service Water	Aug. 6-12	4	1	0	0	0	0	4	1	0
E30	Service Water	Aug. 13-19	4	0	0	0	0	0	4	0	0
E33	Service Water	Aug. 20-26	5	1	0	0	0	0	6	1	0

Table 6(cont.). Summary of number of compounds identified in each concentration range for all samples (92) during 1980.

Sample			Concentration Range								
#	Site	Date	A	B	C	D	E	F	>1 ug/L	>10 ug/L	>1 mg/L
Petrosar											
E52	A/C Filter	Sept. 6	6	2	0	1	0	0	9	3	1
E58	A/C Filter	Sept. 7	2	1	1	1	1	0	6	4	2
E63	A/C Filter	Sept. 8	0	0	0	0	0	0	0	0	0
E67	A/C Filter	Sept. 9	1	0	1	0	0	0	2	1	0
E73	A/C Filter	Sept. 10	3	0	0	2	1	0	6	1	3
E77	A/C Filter	Sept. 11	0	2	2	0	1	0	5	5	1
E82	A/C Filter	Sept. 12	2	0	1	0	1	0	4	2	1
E86	A/C Filter	Sept. 13	5	1	1	1	0	0	8	3	1
E91	A/C Filter	Sept. 14	3	2	1	0	1	0	7	4	1
E51	Biox. Unit	Sept. 6	10	5	1	0	0	0	16	6	0
E57	Biox. Unit	Sept. 7	6	3	0	0	0	0	9	3	0
E62	Biox. Unit	Sept. 8	3	5	3	0	0	0	11	8	0
E66	Biox. Unit	Sept. 9	7	9	4	1	0	0	21	14	1
E72	Biox. Unit	Sept. 10	2	7	9	1	0	0	19	17	1
E76	Biox. Unit	Sept. 11	10	7	1	1	0	0	19	9	1
E81	Biox. Unit	Sept. 12	7	5	4	1	1	0	18	11	2
E85	Biox. Unit	Sept. 13	7	7	6	1	0	0	21	14	1
E90	Biox. Unit	Sept. 14	1	1	6	2	0	0	10	9	2
E49	Chemical DAF	Sept. 6	8	6	1	1	1	0	17	9	2
E55	Chemical DAF	Sept. 7	4	1	2	1	1	0	9	5	2
E60	Chemical DAF	Sept. 8	0	5	4	1	1	0	11	11	2
E64	Chemical DAF	Sept. 9	3	7	2	3	0	0	15	12	3
E70	Chemical DAF	Sept. 10	5	7	4	3	1	0	20	15	4
E74	Chemical DAF	Sept. 11	3	5	4	2	1	0	15	12	3
E79	Chemical DAF	Sept. 12	8	3	0	4	2	0	17	10	6
E83	Chemical DAF	Sept. 13	7	8	1	2	2	0	20	13	4
E88	Chemical DAF	Sept. 14	3	2	2	2	2	0	11	8	4
E53	Final	Sept. 6	8	1	0	0	0	0	9	1	0
E59	Final	Sept. 7	4	1	0	0	0	0	5	1	0
E68	Final	Sept. 9	11	5	0	2	0	0	18	5	2
E78	Final	Sept. 11	8	1	0	0	0	0	9	1	0
E92	Final	Sept. 14	8	3	1	0	0	0	12	4	0
E50	Oily DAF	Sept. 6	7	4	2	1	0	1	15	8	2
E56	Oily DAF	Sept. 7	6	2	1	2	1	0	16	10	3
E61	Oily DAF	Sept. 8	2	4	2	1	1	0	10	8	2
E65	Oily DAF	Sept. 9	9	7	0	1	1	0	18	9	2
E71	Oily DAF	Sept. 10	2	7	2	1	1	0	13	11	2
E75	Oily DAF	Sept. 11	2	7	2	3	0	0	14	12	3
E80	Oily DAF	Sept. 12	7	2	0	3	1	1	14	7	5
E84	Oily DAF	Sept. 13	1	5	4	1	1	0	12	11	2
E89	Oily DAF	Sept. 14	0	3	4	3	1	0	11	11	4

Table 6(cont.). Summary of number of compounds identified in each concentration range for all samples (92) during 1980.

Sample #	Site	Date	Concentration Range A	B	C	D	E	F	>1 ug/L	>10 ug/L	>1 mg/L
Petrosar (cont.)											
E54	Service Water	Sept. 6	5	2	0	0	0	0	7	2	0
E69	Service Water	Sept. 9	10	0	0	0	0	0	10	0	0
E87	Service Water	Sept. 13	7	2	0	0	0	0	9	2	0
Polysar Corporation											
E25	Ditch In	Aug. 12-16	8	1	0	0	0	0	9	1	0
E26	Ditch In	Aug. 17-21	3	0	0	0	0	0	3	0	0
E45	Ditch In	Aug. 22-26	1	2	0	0	0	0	3	2	0
E46	Ditch In	Aug. 27-31	3	0	2	0	0	0	5	2	0
E27	Ditch Out	Aug. 12-16	3	0	0	0	0	0	3	0	0
E28	Ditch Out	Aug. 17-21	2	0	0	0	0	0	2	0	0
E47	Ditch Out	Aug. 22-26	5	1	0	0	0	0	6	1	0
E48	Ditch Out	Aug. 27-31	4	0	0	0	0	0	4	0	0
E23	Service Water	Aug. 12-16	3	1	0	0	0	0	4	1	0
E24	Service Water	Aug. 17-21	1	0	0	0	0	0	1	0	0
E43	Service Water	Aug. 22-26	1	0	0	0	0	0	1	0	0
E44	Service Water	Aug. 27-31	1	0	0	0	0	0	1	0	0

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
3. acid fraction analyzed by GC/MS
4. concentration ranges:
   - A = 1 - 10 ug/L
   - B = 10 - 100 ug/L
   - C = 100 - 1000 ug/L (1000 ug/L = 1 mg/L)
   - D = 1 - 10 mg/L
   - E = 10 - 100 mg/L
   - F = 100 - 1000 mg/L
   - * = peak identified by GC but not confirmed by GC/MS analysis
   - - = peak identified by GC but not confirmed by GC/MS analysis of samples from related sites
5. + = compounds not separated by GC methodology

Table 7. Compounds in final effluents discharged to the St. Clair River in 1979 ranked by percent frequency. (65 samples, including Polysar Ditch Out)

COMPOUND	MCR[1]	PERCENT
Bis(2-ethylhexyl)phthalate	A	59
1,1,2,2-Tetrachloroethane)	A	55
Tetrachloroethylene) *[2]		
Cis-1,3-dichloropropene)		
Benzene) *	B	53
2-Chloroethylvinylether)		
1,2-Dichloroethane	B	45
Chloroform	A	39
Bromoform	A	38
Carbontetrachloride	A	34
Toluene	A	31
Di-n-butyl phthalate	A	28
1,2-Dichloropropane	B	27
N-Nitrosodiphenylamine)		
Hexachlorobenzene)*	B	25
4-Bromophenyl phenyl ether)		
1,1-Dichloroethane	B	23
Trichloroethylene)		
Chlorodibromomethane) *	A	22
1,1,2-Trichloroethane)		
Methylene chloride	B	22
Phenanthrene)	A	20
Anthracene) *		
Pyrene	A	20
4-Nitrophenol	A	19
Naphthalene	A	19
Trans-1,2-dichloroethylene	B	19
Chlorobenzene	A	17
Fluorene)	A	17
4-Chlorophenyl phenyl ether) *		
2,4-Dinitrophenol	B	17
Fluoranthene	A	17
Acenaphthene	A	16
Dimethyl phthalate	A/B	16
Acenaphthylene	A	14
Ethylbenzene	A	14
Phenol	A	14
Bis(2-chloroisoprophyl)ether	A	14
4,6-Dinitro-o-cresol	A	13
1,1,1-Trichloroethane	A/B	13

Table 7 continued.....

COMPOUND	MCR	PERCENT
1,1-Dichloroethylene	A	13
Pentachlorophenol	A/B	13
Diethyl phthalate)	A	11
2,4-Dinitrotoluene) *		
Hexachlorobutadiene	A	11
Dichlorobromomethane)	A	8
Bis(2-chloromethyl)ether) *		
2,4-Dimethylphenol)	A	8
2-Nitrophenol)*		
2,4,6-Trichlorophenol	B	8
Benz(a)anthracene	A	8
Hexachloroethane	A	6
2-Chloronaphthalene	A/B	6
Di-n-octyl phthalate	A	5
Butyl benzyl phthalate	B	5
2,4-Dichlorophenol	A	5
Trans-1,3-dichloropropylene	A	5
Trichlorofluoromethane	A	3
2-Chlorophenol	A	3
Nitrobenzene	B	3
p-Chloro-m-cresol	B	2
Chrysene	B	2
2,6-Dinitrotoluene	A	2
1,2-Diphenylhydrazine	B	2
Benzo(b)fluoranthene)	C	2
Benzo(k)fluoranthene)*		
Benzo(g,h,i)perylene	A	2

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC Methodology

Table 8. Compounds in final effluents discharged to the St. Clair River in 1979 ranked by MCR (65 samples including Polysar Ditch Out).

COMPOUNDS	MCR[1]	PERCENT
Benzo(b)fluoranthene)	C	2
Benzo(k)fluoranthene) *[2]		
Cis-1,3-dichloropropene)		
Benzene) *	B	53
2-Chloroethylvinylether)		
1,2-Dichloroethane	B	45
1,2-Dichloropropane	B	27
N-Nitrosodiphenylamine)		
Hexachlorobenzene) *	B	25
4-Bromophenyl phenyl ether)		
1,1-Dichloroethane	B	23
1,1-Dichloroethylene	B	23
Methylene chloride	B	22
Trans-1,2-dichloroethylene	B	19
2,4-Dinitrophenol	B	17
2,4,6-Trichlorophenol	B	8
Butyl benzyl phthalate	B	5
Nitrobenzene	B	3
p-Chloro-m-cresol	B	2
Chrysene	B	2
1,2-Diphenylhydrazine	B	2
Dimethyl phthalate	A/B	16
Pentachlorophenol	A/B	13
1,1,1-Trichloroethane	A/B	13
2-Chloronaphthalene	A/B	6
Bis(2-ethylhexyl)phthalate	A	59
1,1,2,2-Tetrachloroethane)	A	55
Tetrachloroethylene) *		
Chloroform	A	39
Bromoform	A	38
Carbontetrachloride	A	34
Toluene	A	31
Di-n-butyl phthalate	A	28
Trichloroethylene)		
Chlorodibromomethane) *	A	22
1,1,2-Trichloroethane)		
Phenanthrene)	A	20
Anthracene) *		
Pyrene	A	20
Naphthalene	A	19
4-Nitrophenol	A	19

Table 8 continued.....

COMPOUND	MCR	PERCENT
Fluorene)	A	17
4-Chlorophenyl phenyl ether) *		
Chlorobenzene	A	17
Fluoranthene	A	17
Acenaphthene	A	16
Bis(2-chloroisopropyl)ether	A	14
Phenol	A	14
Ethylbenzene	A	14
Acenaphthylene	A	14
4,6-Dinitro-o-cresol	A	13
Diethyl phthalate)	A	11
2,4-Dinitrotoluene) *		
2,4-Dimethylphenol)	A	8
2-Nitrophenol) *		
Benz(a)anthracene	A	8
Dichlorobromomethane)	A	8
Bis(2-chloromethyl)ether) *		
Hexachloroethane	A	6
Trans-1,3-dichloropropylene	A	5
2,4-Dichlorophenol	A	5
2-Chlorophenol	A	3
Di-n-octyl phthalate	A	5
Trichlorofluoromethane	A	3
2,6-Dinitrotoluene	A	2
Benzo(g,h,i) perylene	A	2

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC Methodology

Table 9. Compounds in all Final Discharges in 1979 (69 samples) ranked by percent frequency (including discharges to the Township Ditch but excluding Polysar Ditch Out).

COMPOUND		MCR[1]	PERCENT
Cis-1,3-dichloropropene	)		
Benzene	) *[2]	B	63
2-Chloroethylvinylether	)		
Bis(2-ethylhexyl)phthalate		A	63
1,1,2,2-Tetrachloroethane	)	A	53
Tetrachloroethylene	) *		
1,2-Dichloroethane		B	49
Di-n-butyl phthalate		A	40
Chloroform		A	38
Bromoform		B	34
Carbontetrachloride		A	32
1,2-Dichloropropane		B	31
Phenanthrene	)	B	31
Anthracene	)*		
Trichloroethylene	)		
Chlorodibrommethane	)*	A	29
1,1,2-Trichloroethane	)		
Toluene		A	29
Pyrene		A	27
1,1-Dichloroethane		B	27
4-Nitrophenol		A	24
Trans-1,2-dichloroethylene		B	24
N-Nitrosodiphenylamine	)		
Hexachlorobenzene	)*	A	22
4-Bromophenyl phenyl ether	)		
Naphthalene		A	22
Fluorene	)	A/B	21
4-Chlorophenyl phenyl ether	)*		
Methylene chloride		B	21
Fluoranthene		A	19
4,6-Dinitro-o-cresol		A/B	18
Chlorobenzene		A	16
Acenaphthylene		A	16
2,4-Dinitrophenol		B	16
Ethylbenzene		A	16
1,1,1-Trichloroethane		B	15
Phenol		A/B	15
Acenaphthene		A	15
Pentachlorophenol		A/B	15
Dichlorobromomethane	)	A	13
Bis(2-chloromethyl)ether	)*		

Table 9 continued.....

COMPOUND	MCR	PERCENT
Hexachlorobutadiene	B	13
Bis(2-chloroisopropyl)ether	A	13
Diethyl phthalate)	A	12
2,4-Dinitrotoluene)*		
2,4,6-Trichlorophenol	B	12
Hexachloroethane	A/B	9
Dimethyl phthalate	A/B	9
Trans-1,3-dichloropropylene	A/B	9
Butyl benzyl phthalate	A/B	6
1,1-Dichloroethylene	A/B	6
2,4-Dimethylphenol)	A	6
2-Nitrophenol)*		
Benz(a)anthracene	A	6
2,4-Dichlorophenol	A	6
2-Chloronaphthalene	A/B	6
Trichlorofluoromethane	A	4
Di-n-octyl phthalate	A	4
2-Chlorophenol	A	4
Nitrobenzene	B	4
Chrysene	A/B	3
1,2,4-Trichlorobenzene	A/B	3
p-Chloro-m-cresol	B	2
1,3-Dichlorobenzene	B	2
1,4-Dichlorobenzene	A	2
Benzo(g,h,i)perylene	A	2
Benzo(b)fluoranthene)	C	2
Benzo(k)fluoranthene) *		
1,2-Diphenylhydrazine	B	2

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC Methodology

Table 10. Compounds in all Final Discharges in 1979 (69 samples) ranked by MCR (including discharges to the Township Ditch but excluding Polysar Ditch Out).

COMPOUND	MCR[1]	PERCENT
Benzo(b)fluoranthene) Benzo(k)fluoranthene)*[2]	C	2
Cis-1,3-dichloropropene) Benzene)* 2-Chloroethylvinylether)	B	63
1,2-Dichloroethane	B	49
Bromoform	B	34
1,2-Dichloropropane	B	31
Phenanthrene) Anthracene)*	B	31
1,1-Dichloroethane	B	27
Trans-1,2-dichloroethylene	B	24
Methylene chloride	B	21
2,4-Dinitrophenol	B	16
1,1,1-Trichloroethane	B	15
Hexachlorobutadiene	B	13
2,4,6-Trichlorophenol	B	12
Nitrobenzene	B	4
1,3-Dichlorobenzene	B	2
p-Chloro-m-cresol	B	2
1,2-Diphenylhydrazine	B	2
Fluorene) 4-Chlorophenyl phenyl ether)*	A/B	21
4,6-Dinitro-o-cresol	A/B	18
Pentachlorophenol	A/B	15
Phenol	A/B	15
Trans-1,3-dichloropropylene	A/B	9
Hexachloroethane	A/B	9
Dimethyl phthalate	A/B	9
1,1-Dichloroethylene	A/B	6
2-Chloronaphthalene	A/B	6
Butyl benzyl phthalate	A/B	6
Chrysene	A/B	3
1,2,4-Trichlorobenzene	A/B	3
Bis(2-ethylhexyl)phthalate	A	63
1,1,2,2-Tetrachloroethane) Tetrachloroethylene)*	A	53
Di-n-butyl phthalate	A	40
Chloroform	A	38
Carbontetrachloride	A	33

Table 10 continued.....

COMPOUND	MCR	PERCENT
Trichloroethylene) Chlorodibromomethane)* 1,1,2-Trichloroethane)	A	29
Toluene	A	29
Pyrene	A	27
4-Nitrophenol	A	24
Naphthalene	A	22
N-Nitrosodiphenylamine) Hexachlorobenzene)* 4-Bromophenyl phenyl ether)	A	22
Fluoranthene	A	19
Chlorobenzene	A	16
Ethylbenzene	A	16
Acenaphthylene	A	16
Bis(2-chloroisopropyl)ether	A	13
Dichlorobromomethane) Bis(2-chloromethyl)ether)*	A	13
Diethyl phthalate) 2,4-Dinitrotoluene)*	A	12
2,4-Dichlorophenol	A	6
Benz(a)anthracene	A	6
2-Chlorophenol	A	4
Trichlorofluoromethane	A	4
Di-n-octyl phthalate	A	4
Benzo(g,h,i)perylene	A	3
1,4-Dichlorobenzene	A	2

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC methodology

Table 11. ESSO Final 1980 - Compounds ranked by Percent Frequency

COMPOUND		MCR[1]	PERCENT
2,4-Dimethylphenol	)[2]*	A	83
2-Nitrophenol	)		
Chloroform (S)[3]		A	50
Cis-1,3-dichloropropene	)		
Benzene	)*	A/B	33
2-Chloroethylvinylether	)		
Toluene		A	17

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC Methodlogy

[3](S) - Also identified in Service Water Samples

Table 12. ESSO Final 1980 - Compounds ranked by MCR

Compound		MCR[1]	PERCENT
Cis-1,3-dichloropropene	)		
Benzene	)*[2]	A/B	33
2-Chloroethylvinylether	)		
2,4-Dimethylphenol	)		
2-Nitrophenol	)*	A	83
Chloroform(S)[3]		A	50
Toluene		A	17

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC Methodlogy

[3](S) - Also identified in Service Water Samples

Table 13. Dow 3rd Street Sewer 1980 - Compounds ranked by Percent Frequency

Compound	MCR[1]	PERCENT
Carbontetrachloride(S)[3]	C	100
1,2-Dichloroethane	B	100
Bis(2-ethylhexyl)phthalate(S)	A	100
1,1,2,2-Tetrachloroethane)(S)	A	100
Tetrachloroethylene)*[2]		
1,1,1-Trichloroethane(S)	A	100
1,2,4-Trichlorobenzene	A	83
Cis-1,3-dichloropropene)		
Benzene)*S	A	67
2-Chloroethylvinylether)		
Naphthalene	A	67
Di-n-butyl phthalate	A	67
Pentachlorophenol	A/B	67
Dimethyl phthalate	A	50
1,4-Dichlorobenzene	B	50
Nitrobenzene	B	50
2-Chloronaphthalene	A	33
Toluene	A	17
Diethyl phthalate)	A	17
2,4-Dinitrotoluene)*		
Fluorene)	A	17
4-Chlorophenyl phenyl ether)*		

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC Methodology

[3](S) - Also identified in Service Water Samples

Table 14. Dow 3rd Street Sewer 1980 - Compounds ranked by MCR

Compound	MCR[1]	PERCENT
Carbontetrachloride(S)[3]	C	100
1,2-Dichloroethane	B	100
1,4-Dichlorobenzene	B	50
Nitrobenzene	B	50
Pentachlorophenol	A/B	67
Bis(2-ethylhexyl)phthalate(S)	A	100
1,1,2,2-Tetrachloroethane)	A	100
Tetrachloroethylene)*[2](S)		
1,1,1-Trichloroethane(S)	A	100
1,2,4-Trichlorobenzene	A	83
Cis-1,3-dichloropropene)		
Benzene)*(S)	A	67
2-Chloroethylvinylether)		
Naphthalene	A	67
Di-n-butyl phthalate	A	67
Dimethyl phthalate	A	50
2-Chloronaphthalene	A	33
Fluorene)	A	17
4-Chlorophenyl phenyl ether)*		
Diethyl phthalate)	A	17
2,4-Dinitrotoluene)*		
Toluene	A	17

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC Methodology

[3](S) - Also identified in Service Water Samples

Table 15. Polysar Township Ditch In 1980 - Compounds ranked Percent Frequency

COMPOUND	MCR[1]	PERCENT
Cis-1,3-dichloropropene) Benzene)*[2] 2-Chloroethylvinylether)	A/B	100
1,1,2,2-Tetrachloroethane) Tetrachloroethylene)* Trichloroethylene)	A/B	100
Chlorodibromomethane)* 1,1,2-Trichloroethane)	A	100
Bis(2-ethylhexyl)phthalate	C	25
Chloroform	A	25
Phenanthrene	A	25
Di-n-butyl phthalate	A	25
Butyl benzyl phthalate	A	25
Di-n-octyl phthalate	A	25
Benzo(b)fluoranthene) Benzo(k)fluoranthene)*	A	25
Pentachlorophenol	A	25

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC Methodology

Table 16. Polysar Township Ditch In 1980 - Compounds ranked by MCR

Compound	MCR[1]	PERCENT
Bis(2-ethylhexyl)phthalate	C	25
Cis-1,3-dichloropropene)		
Benzene)*[2]	A/B	100
2-Chloroethylvinylether)		
1,1,2,2-Tetrachloroethane)	A/B	100
Tetrachloroethylene)*		
Trichloroethylene)		
Chlorodibromomethane)*	A	100
1,1,2-Trichloroethane)		
Pentachlorophenol	A	25
Butyl benzyl phthalate	A	25
Di-n-octyl phthalate	A	25
Benzo(b)fluoranthene)	A	25
Benzo(k)fluoranthene)*		
Di-n-butyl phthalate	A	25
Chloroform	A	25
Phenanthrene	A	25

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC Methodology

Table 17. Polysar Township Ditch Out 1980 - Compounds ranked by Percent Frequency

Compound		MCR[1]	PERCENT
Bis(2-ethylhexyl)phthalate		A	100
1,1,2,2-Tetrachloroethane	)*[2]	A	75
Tetrachloroethylene	)		
Di-n-butyl phthalate		A	50
Butyl benzyl phthalate		A	50
Cis-1,3-dichloropropene	)		
Benzene	)*	A	25
2-Chloroethylvinylether	)		
Toluene		A	25
Pyrene		A	25
Methylene chloride(S)[3]		B	25

[1]MCR - Median Concentration Range

[2]*) - Compounds not separated bu GC Methodology

[3](S) - Also identified in Service Water Samples

Table 18. Polysar Township Ditch Out 1980 - Compounds ranked by MCR.

Compound		MCR[1]	PERCENT
Methylene chloride(S)[3]		B	25
Bis(2-ethylhexyl)phthalate		A	100
1,1,2,2-Tetrachloroethane	)*	A	75
Tetrachloroethylene	)[2]		
Butyl benzyl phthalate		A	50
Di-n-butyl phthalate		A	50
Cis-1,3-dichloropropene	)		
Benzene	)*	A	25
2-Chloroethylvinylether	)		
Pyrene		A	25
Toluene		A	25

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC Methodoloy

[3](S) - Also identified in Service Water Samples

Table 19. Ethyl Final 1980 - Compounds ranked by Percent Frequency

COMPOUND		MCR[1]	PERCENT
Pentachlorophenol		A	50
Cis-1,3-dichloropropene	)*[2](S)[3]	A	33
Benzene	)*[2](S)[3]	A	33
2-Chloroethylvinylether	)*[2](S)[3]	A	33
Methylene chloride		D	17
1,1,1-Trichloroethane(S)		A	17

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC Methodology

[3](S) - Also identified in Service Water Samples

The treatment system did reduce the concentration of many compounds. Each component of the treatment system was effective in reducing different classes of organic compounds.

The findings contained in this report and other surveys carried out in the area have resulted in numerous process modifications and improvements in waste treatment facilities to reduce organic pollution from Sarnia-area industries.

This study has resulted in the initiation of further assessments to determine the significance of these organic compounds to water, sediment and aquatic life within the St. Clair River-Lake St. Clair system.

"The report is an important data base for our ministry's ongoing investigation of contaminants in the St. Clair-Detroit rivers eco-system," Mr. Bradley said, "and it will be useful in evaluating future changes in the area."

-30-

MINISTRY OF THE ENVIRONMENT
SEP 16 1985
HAZARDOUS CONTAMINANTS OFFICE

Ontario

news release

September 13, 1985

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ENVIRONMENT MINISTRY RELEASES REPORT ON POINT SOURCE DISCHARGES TO ST. CLAIR RIVER

Environment Ontario is releasing a report on the findings of a two-year survey of pollutant discharges to the St. Clair River, Environment Minister Jim Bradley announced today.

The St. Clair River Point Source Survey was undertaken jointly by Environment Ontario and Environment Canada during 1979 and 1980. During the survey, 235 samples were collected from industrial discharges, process sewers and service waters in the St. Clair River area.

The samples were analyzed for 78 major hazardous pollutants, of which 74 were identified at least once during the survey. More than half the industrial discharges sampled contained the chemicals Benzene, Cis-1,3-dischloropropene, 1,1,2,2-Tetrachloroethane, Tetrachloroethylene, Bis(2-ethylhexyl) phthalate.

During 1980, four discharge sources were extensively monitored. Very few pollutants turned up consistently in any one discharge and the concentration levels of the pollutants varied greatly from sample to sample.

To evaluate whether a conventional treatment facility could reduce or remove hazardous organic pollutants, the Petrosar wastewater treatment system at Sarnia was continuously sampled for nine days.

...2/

INTERNATIONAL YOUTH YEAR 1985

Table 20. Ethyl Final 1980 - Compounds ranked by MCR

COMPOUND		MCR[1]	PERCENT
Methylene chloride		D	17
Pentachlorophenol		A	50
Cis-1,3-dichloropropene	)*[2](S)[3]	A	33
Benzene	)*[2](S)[3]		
2-Chloroethylvinylether	)*[2](S)[3]		
1,1,1-Trichloroethane(S)		A	17

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC methodology

[3](S) - Also identified in Service Water Samples

Table 21. Petrosar, Oily DAF 1980 - Compounds ranked by Percent Frequency

COMPOUND	MCR[1]	PERCENT
Cis-1,3-dichloropropene)		
Benzene)*[2]	E	100
2-Chloroethylvinylether)		
Toluene	D	100
Ethylbenzene	C	100
2,4-Dimethylphenol)	C/D	89
2-Nitrophenol)*		
Fluorene)	B	89
4-Chlorophenyl phenyl ether)*		
Phenanthrene)	B	89
Anthracene)*		
Acenaphthylene	A/B	89
Acenaphthene	B	78
Naphthalene	B	56
Bis(2-ethylhexyl)phthalate	B	56
Di-n-butyl phthalate	B	56
Fluoranthene	B	56
Methylene chloride	B	44
Pyrene	A/B	44
1,2-Dichloroethane	A	44
Chloroform	A	44
1,1,2,2-Tetrachloroethane)	A	33
Tetrachloroethylene)*		
1,1,1-Trichloroethane)	A	33
Trichloroethylene		
Chlorodibromomethane *	A	33
1,1,2-Trichloroethane		
Phenol	C	33
Diethyl phthalate)	B	22
2,4-Dinitrotoluene)*		
Chrysene	A	11
1,2-Diphenylhydrazine	B	11
N-Nitrosodiphenylamine)		
Hexachlorobenzene)*	A	11
4-Bromophenyl phenyl ether)		

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC Methodology

Table 22. Petrosar, Oily DAF 1980 - Compounds ranked by MCR

COMPOUND	MCR[1]	PERCENT
Cis-1,3-dichloropropene)		
Benzene)*[2]	E	100
2-Chloroethylvinylether)		
2,4-Dimethylphenol)	C/D	89
2-Nitrophenol)*		
Toluene	C	100
Ethylbenzene	C	100
Phenol	C	33
Fluorene)	B	89
4-Chlorophenyl phenyl ether)*		
Acenaphthene	B	78
Di-n-butyl phthalate	B	56
Bis(2-ethylhexyl)phthalate	B	56
Fluoranthene	B	56
Naphthalene	B	56
Methylene chloride	B	44
Diethyl phthalate)	B	22
2,4-Dinitrotoluene)*		
1,2-Diphenylhydrazine	B	11
Phenanthrene)	A/B	89
Anthracene)*		
Pyrene	A/B	44
Acenaphthylene	A	89
Chloroform	A	44
1,2-Dichloroethane	A	33
Trichloroethylene)		
Chlorodibromomethane) *	A	33
1,1,2-Trichloroethane)		
1,1,1-Trichloroethane	A	33
1,1,2,2-Tetrachloroethane)	A	33
Tetrachloroethylene)*		
N-Nitrosodiphenylamine)		
Hexachlorobenzene)*	A	11
4-Bromophenyl phenyl ether)		
Chrysene	A	11

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC Methodology

Table 23. Petrosar, Chemical DAF 1980 - Compounds ranked by Percent Frequency

COMPOUND	MCR[1]	PERCENT
Cis-1,3-dichloropropene) Benzene)*[2] 2-Chloroethylvinylether)	E	100
2,4-Dimethylphenol) 2-Nitrophenol)*	D	100
Toluene	D	100
Phenol	D	100
Ethylbenzene	C	100
Phenanthrene) Anthracene)*	B	89
1,1,2,2-Tetrachloroethane) Tetrachloroethylene)*	A	89
Fluorene) 4-Chlorophenyl phenyl ether)*	B	78
Methylene chloride	B	78
1,2-Dichloroethane	A	78
Naphthalene	B	67
Chloroform	A	67
Bis(2-ethylhexyl)phthalate	B	56
Fluoranthene	B	56
1,1,1-Trichloroethane	A	56
Pyrene	B	44
Acenaphthene	B	44
Acenaphthylene	A	44
Di-n-butyl phthalate	B	33
Trichloroethylene) Chlorodibromomethane)* 1,1,2-Trichloroethane)	A	33
N-Nitrosodiphenylamine) Hexachlorobenzene)* 4-Bromophenyl phenyl ether)	B	22
Benz(a)anthracene	A/B	22
Di-n-octyl phthalate	A	11
Nitrobenzene	A	11
1,3-Dichlorobenzene	B	11
Trans-1,2-dichloroethylene	A	11
Diethyl phthalate) 2,4-Dinitrotoluene)*	A	11

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC Methodology

Table 24. Petrosar, Chemical DAF 1980 - Compounds ranked by MCR

COMPOUND	MCR[1]	PERCENT
Cis-1,3-dichloropropene) Benzene)*[2] 2-Chloroethylvinylether)	E	100
2,4-Dimethylphenol) 2-Nitrophenol)*	D	100
Toluene	D	100
Phenol	D	100
Ethylbenzene	C	100
Phenanthrene) Anthracene)*	B	89
Fluorene) 4-Chlorophenyl phenyl ether)*	B	78
Methylene chloride	B	67
Bis(2-ethylhexyl)phthalate	B	56
Fluoranthene	B	56
Naphthalene	B	67
Acenaphthene	B	44
Pyrene	B	44
Di-n-butyl phthalate	B	33
N-Nitrosodiphenylamine) Hexachlorobenzene)* 4-Bromophenyl phenyl ether)	B	22
1,3-Dichlorobenzene	B	11
Benz(a)anthracene	A/B	22
1,1,2,2-Tetrachloroethane) Tetrachloroethylene)*	A	89
1,2-Dichloroethane	A	78
Chloroform	A	67
1,1,1-Trichloroethane	A	56
Acenaphthylene	A	44
Trichloroethylene) Chlorodibromomethane)* 1,1,2-Trichloroethane)	A	33
Trans-1,2-dichloroethylene	A	11
Diethyl phthalate) 2,4-Dinitrotoluene)*	A	11
Nitrobenzene	A	11
Di-n-octyl phthalate	A	11

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC Methodology

Table 25. Petrosar, Biox Unit 1980 - Compounds ranked by Percent Frequency

COMPOUND	MCR[1]	PERCENT
Cis-1,3-dichloropropene) Benzene)*[2] 2-Chloroethylvinylether)	C	100
Toluene	C	100
Phenanthrene) Anthracene)*	B	100
1,2-Dichloroethane	A	100
1,1,2,2-Tetrachloroethane) Tetrachloroethylene)*	A	76
Methylene chloride	B	67
2,4-Dimethylphenol) 2-Nitrophenol)*	D	89
Ethylbenzene	B	89
Acenaphthylene	B	89
Fluorene) 4-Chlorophenyl phenyl ether)*	B	89
Acenaphthene	C	78
Bis(2-ethylhexyl)phthalate	C	78
Trichloroethylene) Chlorodibromomethane)*	A	67
1,1,2-Trichloroethane)		
1,1,1-Trichloroethane	A	56
Di-n-butyl phthalate	B	56
Naphthalene	A	56
Chloroform	A	44
Fluoranthene	B	44
Pyrene	B	44
1,1-Dichloroethylene	A	33
Chrysene	B/C	22
Di-n-octyl phthalate	A/B	22
Benz(a)anthracene	A/C	22
Phenol	D	11
N-Nitrosodiphenylamine) Hexachlorobenzene)* 4-Bromophenyl phenyl ether)	C	11
Benzo(b)fluoranthene) Benzo(k)fluoranthene)*	C	11
Diethyl phthalate) 2,4-Dinitrotoluene)*	B	11
1,2-Diphenylhydrazine	B	11
1,3-Dichlorobenzene	A	11
Butyl benzyl phthalate	A	11

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC Methodology

Table 26. Petrosar, Biox Unit 1980 - Compounds ranked by MCR

COMPOUND	MCR[1]	PERCENT
2,4-Dimethylphenol) 2-Nitrophenol)*[2]	D	89
Phenol	D	11
Cis-1,3-dichloropropene) Benzene)* 2-Chloroethylvinylether)	C	100
Toluene	C	100
Acenaphthene	C	78
Bis(2-ethylhexyl)phthalate	C	78
N-Nitrosodiphenylamine) Hexachlorobenzene)* 4-Bromophenyl phenyl ether)	C	11
Benzo(b)fluoranthene) Benzo(k)fluoranthene)*	C	11
Chrysene	B/C	22
Benz(a)anthracene	A/C	22
Phenanthrene) Anthracene)*	B	100
Ethylbenzene	B	89
Acenaphthylene	B	89
Methylene chloride	B	67
Di-n-butyl phthalate	B	56
Fluorene) 4-Chlorophenyl phenyl ether)*	B	56
Naphthalene	A	56
Pyrene	B	44
Fluoranthene	B	44
Diethyl phthalate) 2,4-Dinitrotoluene)*	B	11
1,2-Diphenylhydrazine	B	11
Di-n-octyl phthalate	A/B	22
1,2-Dichloroethane	A	100
1,1,2,2-Tetrachloroethane) Tetrachloroethylene)*	A	76
Trichloroethylene) Chlorodibromomethane)* 1,1,2-Trichloroethane)	A	67
1,1,1-Trichloroethane	A	56
Chloroform	A	44
1,1-Dichloroethylene	A	33
1,3-Dichlorobenzene	A	11
Butyl benzyl phthalate	A	11

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC Methodology

Table 27. Petrosar, A/C Filter 1980 - Compounds ranked by Percent Frequency

COMPOUND	MCR[1]	PERCENT
Cis-1,3-dichloropropene) Benzene)*[2] 2-Chloroethylvinylether)	E	89
Phenol	C	67
Toluene	B	56
2,4-Dimethylphenol) 2-Nitrophenol)*	C	56
1,2-Dichloroethane	A	44
Ethylbenzene	B	44
Chloroform	A	33
Bis(2-ethylhexyl)phthalate	A	33
1,1-Dichloroethylene	A	22
Di-n-butyl phthalate	A	22
1,1,2,2-Tetrachloroethane) Tetrachloroethylene)*	A	11
Naphthalene	A	11
1,1,1-Trichloroethane	A	11
Pyrene	A	11
Methylene chloride	B	11

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC Methodology

Table 28. Petrosar, A/C Filter 1980 - Compounds ranked by MCR

COMPOUND	MCR[1]	PERCENT
Cis-1,3-dichloropropene)		
Benzene)*[2]	E	89
2-Chloroethylvinylether)		
Phenol	C	67
2,4-Dimethylphenol)	C	56
2-Nitrophenol)*		
Toluene	B	56
Ethylbenzene	B	44
Methylene chloride	B	11
1,2-Dichloroethane	A	44
Chloroform	A	33
Bis(2-ethylhexyl)phtalate	A	33
Di-n-butyl phthalate	A	22
1,1-Dichloroethylene	A	22
Pyrene	A	11
1,1,1-Trichloroethane	A	11
Naphthalene	A	11
1,1,2,2-Tetrachloroethane)	A	11
Tetrachloroethylene)*		

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC Methodology

Table 29. Petrosar, Final Discharge 1980 - Compounds ranked by Percent Frequency

COMPOUND	MCR[1]	PERCENT
Cis-1,3-dichloropropene) Benzene)*[2](S)[3] 2-Chloroethylvinylether)	B	100
1,2-Dichloroethane(S)	A	100
Chloroform(S)	A	100
Phenanthrene	A	100
Fluorene) 4-Chlorophenyl phenyl ether)*	A	80
Acenaphthene	B	60
Acenaphthylene	A	60
2,4-Dimethylphenol) 2-Nitrophenol)*	B	60
Naphthalene	A	40
Bis(2-ethylhexyl)phthalate(S)	A	40
Ethylbenzene	A/B	40
Di-n-butyl phthalate(S)	A/B	40
Fluoranthene	A	40
Diethyl phthalate) 2,4-Dinitrotoluene)*	A/B	40
Toluene(S)	A	20
Pyrene	A	20
Benz(a)anthracene	A	20
Butyl benzyl phthalate	A	20
1,1-Dichloroethylene	A	20
1,1,1-Trichloroethane	A	20
Chrysene	A	20

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC Methodology

[3](S) - Also identified in Service Water Samples

Table 30. Petrosar, Final Discharge 1980 - Compounds ranked by MCR

COMPOUND	MCR[1]	PERCENT
Cis-1,3-dichloropropene) Benzene)*[2](S)[3] 2-Chloroethylvinylether)	B	100
2,4-Dimethylphenol) 2-Nitrophenol)*	B	60
Acenaphthene	B	60
Ethylbenzene	A/B	40
Di-n-butyl phthalate(S)	A/B	40
Diethyl phthalate) 2,4-Dinitrotoluene)*	A/B	40
1,2-Dichloroethane(S)	A	100
Chloroform(S)	A	100
Phenanthrene	A	100
Fluorene) 4-Chlorophenyl phenyl ether)*	A	80
Acenaphthylene	A	60
Fluoranthene	A	40
Naphthalene	A	40
Bis(2-ethylhexyl)phthalate(S)	A	40
Butyl benzyl phthalate	A	20
Chrysene	A	20
Pyrene	A	20
Benz(a)anthracene	A	20
Toluene(S)	A	20
1,1-Dichloroethylene	A	20
1,1,1-Trichloroethane	A	20

[1]MCR - Median Concentration Range

[2]* - Compounds not separated by GC Methodology

[3](S) - Also identified in Service Water Samples

6.0 DISCUSSION

This study was designed primarily as a screening survey to develop a base line data set for organic pollutants in a highly industrialized area.

During the two years of sampling in the St. Clair River area a total of 241 samples were collected and analyzed by gas chromatography for the 78 organic pollutants listed. Of these samples 87 were further analyzed by GC/MS to give further confidence in the identification of the compounds. Although the sampling programmes were designed to give an indication of the presence and concentration range of these compounds, they were not designed to establish mass loadings of any of these compounds to the environment.

At the time of this study, many of the industries had secondary biological treatment for their wastewater. Since this time, when additional improvements in wastewater quality were required, the companies have either installed tertiary treatment or have redirected additional waste streams to their secondary system. In many cases waste streams were controlled at the source by either providing better housekeeping or by collection and recycle. In other instances the streams that previously received only primary treatment such as air flotation or gravity separation have been directed to secondary treatment for dissolved organics removal.

6.1 1979 PROGRAMME

A total of 74 organic priority pollutants were identified in the 143 samples analyzed. Of these compounds 65 were found at concentrations greater than 10 ug/L.

In general the service water samples (St. Clair River water) had the least number of compounds at the lowest concentration ranges while the in-plant process streams had the most compounds at the highest concentration ranges.

The process streams generally contained compounds at higher concentration ranges than the corresponding final discharge. There are two reasons for this. The process streams sampled consisted of raw wastes prior to treatment. Although many of the treatment plants were not designed to specifically remove these compounds it would be expected there would be some removal during treatment. Secondly, most of these industries use large quantities of OTCW which is usually combined with the treated process waste prior to discharge as the final effluent.

In each of the cases in 1979 where samples of untreated process waste (raw) as well as final effluent were analyzed there was a reduction in the number of compounds identified. Esso Chemical had a reduction from 17 to 13, as well as fewer compounds in the higher concentration ranges. Sun Oil had a reduction from 22 in the raw untreated waste to 12 in the final discharge and those identified in the final were primarily in the 1-10 µg/L range. The most dramatic reduction was observed at IOEL where the raw wastes averaged 23 compounds most of which were at concentrations greater than 10 µg/L. The final discharge averaged less than six compounds which were nearly always less than 10 µg/L.

A total of 71 different priority pollutants were identified in the 69 samples of final discharges in 1979. These are compounds discharged directly to the St. Clair River or indirectly via surface drainage. The number of pollutants in final discharges from chemical plants ranged from 1 (phenol in the 1-10 µg/L range) in the Dow 3rd St. Sewer on July 18, to 27 compounds in the Dow Acid Tile Drain on August 15. Of the 27 pollutants in this sample 16 were at levels greater than 10 µg/L, including 1,1,2,2-tetrachloroethane/tetrachloroethylene identified in the 10-100 µg/L range.

Two other discharges had more compounds identified than the Dow Acid Tile Drain. These were the surface drainage from the Fiberglas Disposal Site in which 30 compounds were identified for the sample collected August 29 and the discharge of the Pt. Edward WPCP yielding 33 pollutants in the sample collected August 22.

Six pollutants were identified in more than 50% of the final discharge samples. These were:

Benzene)
Cis-1,3-dichloropropene)*
2-Chloroethylvinylether)
1,1,2,2-Tetrachloroethane)*
Tetrachloroethylene)
Bis (2-ethylhexyl) phthalate

*These compounds were not separated by the methodology used.

There were 33 compounds identified at levels greater than 100 µg/L in final discharges with the following eight at levels greater than 1 mg/L.

1,2-Dichloroethane
Trans-1,3-dichloropropylene
Cis-1,3-dichloropropene)
Benzene)*
2-Chloroethylvinylether)
1,1,2,2-Tetrachloroethane)*
Tetrachloroethylene)
Hexachloroethane

Of these, benzene/cis-1,3-dichloropropene/2-chloroethylvinylether was identified in the 10-100 mg/L range in the Polysar Stereo API discharge on August 16. In the Dow Chemical Acid Tile Drain,

1,1,2,2-tetrachloroethane/tetrachoroethylene was found in the 10-100 mg/L range on August 15.

Data for service water samples directly represents the levels of compounds in the nearshore area of St. Clair River. Thirty-three compounds were identified in the 24 samples collected at the eight intakes. Of these compounds six were identified at levels greater than 10 µg/L on 14 occasions during 1979. The detection of priority pollutants at these levels may be a matter of concern because currently available water quality objectives established by environmental agencies for aquatic life and human health protection are generally lower than 10 µg/L.

Priority Pollutant found at 10-100 µg/L levels in Service Water Samples	Surface Water Quality Objective µg/L
1,2-dichloroethane	0.80 (1)
Chloroform	0.20 (1)
Trans-1,2-dichloroethylene	50.00 (1)
1,2-dichloropropane	50.00 (1)
Di-n-butyl phthalate	4.00 (1,2)
Bis(2-ethylhexyl)phthalate	0.60 (1,2)

Priority Pollutant found at 1-10 µg/L levels in Service Water Samples	Surface Water Quality Objective µg/L
1,1-Dichloroethane	50.00 (1)
Benzene	1.50 (1)
Carbontetrachloride	0.40 (1)
1,1,2,2-tetrachloroethane	0.20 (1)
Dichlorobromomethane	50.00 (1)
Bromoform	50.00 (1)
Pentachlorophenol	0.40 (1)

(1) New York State Dept. of Environmental Conservation, "Proposed Ambient Water Quality Standards', 1984.

(2) International Joint Commission, "New and Revised Great Lakes Water Quality Objectives, Volume II", October, 1977.

Although these compounds have been identified in the service water samples it is difficult to identify the major sources of the pollutants because the industrial outfalls and intakes are so close to each other.

6.1.1 Related Studies

In 1979 the Canadian Federal Government contracted the B.C. Cancer Research Centre to assess the mutagenic activity of 27 of the samples. Straight effluent was tested for Salmonella mutagenicity while sample extracts were subjected to four tests. These were the Salmonella mutagenicity, Chromosome aberration, DNA Repair and DNA Repair Inhibition Tests. All tests were conducted with and without S9 rat liver extract. No activity was found in any of the samples when straight effluent was tested, and only very limited

activity was found when the effluent extracts were tested. The limited activity was noted primarily in the DNA Repair Inhibition Test. The significance of activity in sample extracts has not been established.

Many of the final discharges were tested by Ontario Ministry of the Environment for acute toxicity during the summer of 1979. These results are summarized in Appendix H. Few of the discharges exhibited any acute lethality and in all cases it could be attributed to conventional parameters such as extremes of pH.

6.2 1980 PROGRAMME

In 1980, four discharges to the St. Clair River were selected for investigation to determine the variation and frequency of occurrence of priority organic pollutants. Petrosar was selected for detailed sampling to determine if these pollutants were removed or significantly reduced by conventional treatment.

6.2.1 Esso Chemical - Final Discharge

During the sampling of the Esso Chemical discharge in 1980 only chloroform and 2,4-dimethylphenol/4 nitrophenol were identified in half or more of the samples. Chloroform was also identified in the service water. These compounds were measured at levels less than 10 µg/L. On one occasion benzene/cis-1,3-dichloropropene/2-chloroethylvinylether were measured in the 10-100 µg/L range. No compound was identified in all final effluent samples.

6.2.2 Dow Chemical - 3rd Street Sewer

The Dow 3rd Street Sewer had 22 compounds identified during the 1980 sampling, of which 16 occurred in 50% of the samples. Six of these compounds were measured in all of the samples. These were:

Carbontetrachloride
1,2-Dichloroethane
Bis(2-ethylhexyl) phthalate
1,1,2,2-Tetrachloroethane)
Tetrachloroethylene)*
1,1,1-Trichloroethane

*Not separated by GC methodology.

Of these compounds carbontetrachloride was always at levels greater than 10 µg/L and in two thirds of the samples was in the 100 µg/L-1 mg/L range. On one occassion 1,4-dichlorobenzene was measured in the 100 µg/L-1 mg/L range. Because of the large volume of flow in this discharge these compounds represent significant discharges to the St. Clair River.

6.2.3 Ethyl Corporation - Final Discharge

Only two compounds, methylene chloride and pentachlorophenol were identified in the final discharge that were not in the service water. Methylene chloride was only identified once at a very high level (1-10mg/L). This may represent contamination during the analysis as it was not identified in the 1979 final discharge samples and it is also used extensively in the laboratory. Pentachlorophenol was identified in 50% of the samples with one sample measured in the 10-100µg/L range. This frequency of occurrence was identical to that of 1979.

During other sampling programs 1,2 dichloroethane has been identified at high concentrations (over 1 mg/L) in the final discharge. Remedial action has been taken be Ethyl Corporation and the levels of 1,2-dichloroethane have been substantially reduced.

6.2.4 Polysar - Township Ditch Out

The Polysar Ditch Out samples had very few organic compounds present. After taking into account compounds in the Service Water and Ditch In Samples, only toluene and pyrene were identified in these samples on one occasion each in the 1-10µg/L range. The discharges to the Township Ditch as it

passes through Polysar property are primarily OTCW. These discharges represent about 85% of the flow of the Township Ditch as it enters the St. Clair River. Any compounds in the Ditch In would be greatly diluted by this flow. This is evident in that the Ditch In had more compounds (11 vs 8) at higher ranges (two at 100µg/L-1mg/L range vs one at 10-100µg/L range) than the Ditch Out. It does not appear that Polysar is contributing significantly to the contaminant load of the Township Ditch.

During 1979/80 Polysar's process wastes were discharged directly to the St. Clair River via the 54 Inch Sewer, Stereo API Sewer, 66 Inch Sewer and the 72 Inch Sewer. Process wastewater is now treated biologically prior to discharge to the Township Ditch.

6.2.5 Petrosar Treatment Plant

During the nine days of intensive sampling at Petrosar the frequency of occurrence and the median concentration ranges of identified compounds was higher entering the system than leaving it.

For benzene/cis-1,3-dichloropropene/2-chloroethylvinylether, toluene and ethylbenzene the Biox-unit reduced the concentrations by approximately two levels of magnitude during the study period. For these compounds, the A/C Filter reduced the concentrations in only half of the samples.

Methylene chloride and 1,1,2,2-tetrachloroethane/ tetrachloroethylene were only reduced on two of nine days by the Biox-unit while the A/C filter reduced their concentrations on about half of the days sampled.

The Biox-unit did not reduce the concentrations of phenol, 2,4-dimethylphenol/2-nitrophenol, phthalates including

di-n-butylphthalate and bis(2-ethylhexyl)phthalate or PAH's including acenaphthene, acenaphthylene, fluorene, fluoranthene, phenanthrene and pyrene. All of these compounds were reduced by the A/C Filter.

In summary the Biox-unit is effective in reducing the concentration of single ring aromatics such as benzene, toluene and ethyl benzene but is not effective for PAH's, phthalates or volatile chlorinated aliphatics such as methylene chloride and 1,1,2,2-tetrachloroethane. However, the A/C Filter was effective in reducing the concentrations of these PAH's, phthalates and chlorinated aliphatics as well as reducing the concentrations of other pollutants less effectively.

The final effluent discharge is a combination of treatment plant discharge and cooling tower blowdown. Concentrations of pollutants in this final effluent should be lower than those in the A/C Filter effluent. The data for the five final effluent samples do not relate directly to the daily treatment plant samples due to the long residence time in the final holding pond.

7.0 CONCLUSIONS

In 1979, a total of 71 different selected Priority Pollutants were identified in the final discharges to the St. Clair River or indirectly via surface drainage to the river. Several final discharges were identified as having a number of these Priority Pollutants detected at the 100-1000 µg/L concentration level or higher. The 1980 intensive survey also identified a number of priority pollutants at similar concentration levels in the final discharges samples.

During the two year study period, many of these same pollutants were identified at lower concentrations in the industrial service water samples (untreated nearshore St. Clair River water.) The

concentrations of some of these pollutants exceed currently available surface water quality objectives established by environmental agencies for aquatic life and human health protection.

The concentration levels of priority pollutants detected in the samples collected for this study were highly variable (up to three orders of magnitude); some compounds were not consistently identified in samples collected at a given location or were not confirmed in the second year of sampling. These results are similar to those reported in other studies on the variability of trace organics in point source effluents.

Due to resource constraints and other limitations, the data generated by this study are in general of a semi-qualitative and semi-quantitative nature. In particular, owing to sampling handling and storage procedures utilized, the results for volatiles probably underestimate the actual concentrations. In addition, the low sampling frequency employed in this study, and the above-noted data variability were the major factors in determining that the survey data should not be used for mass loading calculations.

The in-plant process waste streams studied generally had more compounds at higher concentration ranges than the corresponding final discharges. This was not unexpected as samples of such process streams were collected before they were treated and/or combined with once through cooling waters.

Data collected from the Petrosar waste treatment system indicate that the conventional secondary waste treatment process (i.e. the bio-oxidation unit) and the tertiary treatment process (i.e. the activated carbon unit) are effective in reducing many of the pollutants detected in the process effluents.

8.0 RECOMMENDATIONS

1) Data from this study should be assessed and used where still applicable by the industries in the design of monitoring and abatement programs for the pollutant sources identified. Priorities should be given to those final discharges with pollutants detected at relatively elevated levels (100-1000 ppb or higher). Confirmation of the 79/80 survey data would be the first step in this process.

2) Industries discharging hazardous contaminants should be required to provide adequate systematic monitoring of effluent volumes and quality to estimate average concentrations and loadings of the contaminants to the St. Clair River.

3) The fate and significance of compounds discharged to the St. Clair River should be assessed by the industries responsible, based on guidelines developed in co-operation with the Ministry of the Environment. Emphasis should be given to those pollutants detected in the service water samples at high concentration ranges (10-100 ppb level or higher).

4) It is essential to clarify the bio-accumulation potential of the contaminants identified throughout the aquatic food chain and potential effects on the aquatic ecosystem and human health. Priority attention should be given to contaminant levels in sport and commercial species within the St. Clair-Detroit River corridor.

5) In cases where industrial sources of trace organics are difficult to pinpoint, samples of process waste streams should be collected prior to combining with once through cooling waters. This would preclude the dilution of certain contaminants to concentrations below the analytical detection limits.

6) In the design of future studies the following should be included:

   (i) The final use of the data and the analytical approach should be compatible.

   (ii) For survey data of effluents and other complex samples the use of GC/MS for a wide target range of compounds should be used for the estimation of concentration levels.

   (iii) Intensive surveys of point sources for the purposes of massloading calculations should use survey data to determine chemicals of concern. Analytical methodology which gives adequate specificity for those target compounds should be used. The specificity can be introduced by the use of GC/MS or other selective detectors.

9.0 ABBREVIATIONS

A/C - activated carbon

API - American Petroleum Institute

BIOX - biological oxidation treatment

BOD - biochemical oxygen demand

DAF - dissolved air flotation

DIC - dissolved inorganic carbon

DOC - dissolved organic carbon

ECD - electron capture detector

EDC - ethylene dichloride

FID - flame ionization detector

OTCW - once through cooling water

POW - potentially oily water

PTC - particulate carbon

SS - suspended solids

TEL - tetraethyl lead

TML - tetramethyl lead

TOC - total organic carbon

TS - total solids

WPCP - water pollution control plant

10.0 REFERENCES

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APPENDIX A

SAMPLES COLLECTED DURING 1979 AND 1980

Table A1. Samples collected in 1979 listed by sample number.

Sample Number	Company	Sample site	Date	Type [1]	Method [2]
01	Polysar	Service Water	June 12	W	C
02	Polysar	Stereo API	June 12	F	C
03	Polysar	66" Sewer	June 12	F	C
04	Polysar	54" Sewer	June 12	F	C
05	Polysar	72" Sewer	June 12	F	C
07	Polysar	Ditch Out	June 12	D	C
09	Township Ditch	Scott Rd. Ditch	June 14	D	G
019	Dow	Service Water	June 20	W	G
020	Dow	42" Sewer	June 20	F	G
021	Dow	48" Sewer	June 20	F	G
022	Dow	54" Sluice	June 20	F	G
023	Dow	Acid Tile Drain	June 20	F	G
024	Dow	3rd St. Sewer	June 20	F	G
025	Sun Oil	Service Water	June 21	W	G
026	Sun Oil	Raw	June 21	P	G
027	Sun Oil	Treated	June 21	P	G
028	Sun Oil	Final	June 21	F	G
029	Polysar	Service Water	June 27	W	C
030	Polysar	Stereo API	June 27	F	C
031	Polysar	66" Sewer	June 27	F	C
032	Polysar	54" Sewer	June 27	F	C
033	Polysar	72" Sewer	June 27	F	C
034	Polysar	Ditch In	June 27	D	G
035	Polysar	Ditch Out	June 27	D	C
036	Township Ditch	Scott Rd. Ditch	June 27	D	G
037	Sun Oil	Service Water	July 17	W	G
038	Sun Oil	Final	July 17	F	G
039	Sun Oil	Raw	July 17	P	G
040	Sun Oil	Treated	July 17	P	G
041	Dow	Service Water	July 18	W	G
042	Dow	42" Sewer	July 18	F	G
043	Dow	48" Sewer	July 18	F	G
044	Dow	54" Sluice	July 18	F	G
045	Dow	Acid Tile Drain	July 18	F	G
046	Dow	3rd St. Sewer	July 18	F	G
047	Dupont	Service Water	July 24	W	G
048	Dupont	Final	July 24	F	G
049	Petrosar	Service Water	July 25	W	G
050	Petrosar	DAF	July 25	P	G
051	Petrosar	Biox. Unit	July 25	P	G
052	Petrosar	A/C Filter	July 25	P	G
053	Petrosar	Final	July 25	F	G
054	IOEL	Service Water	July 25	W	G
055	IOEL	Raw	July 25	P	G
057	ESSO Chemical	A/C Filter	July 25	P	G
058	ESSO Chemical	Final	July 25	F	G
059	IOEL	Final (Comp.)	July 25	F	G
060	C.I.L.	Service Water	July 26	W	G

Table A1 (cont.). Samples collected in 1979 listed by sample number.

Sample Number	Company	Sample site	Date	Type [1]	Method [2]
061	C.I.L.	Final	July 26	F	G
062	Petrosar	Service Water	July 31	W	G
063	Petrosar	DAF	July 31	P	G
064	Petrosar	Biox. Unit	July 31	P	G
065	Petrosar	A/C Filter	July 31	P	G
066	Petrosar	Final	July 31	F	G
067	Ethyl	Neutralization Pit	July 31	P	G
068	Ethyl	Final	July 31	F	G
069	Shell Oil	Service Water	Aug. 1	W	G
070	Shell Oil	Biox. Unit	Aug. 1	F	G
070a	Shell Oil	Cooling Water	Aug. 1	F	G
072	IOEL	Service Water	Aug. 2	W	G
073	IOEL	Raw	Aug. 2	P	G
074	IOEL	Final	Aug. 2	F	G
075	ESSO Chemical	Raw	Aug. 2	P	G
076	ESSO Chemical	Dual Media Filter	Aug. 2	P	G
077	ESSO Chemical	A/C Filter	Aug. 2	P	G
078	ESSO Chemical	Final	Aug. 2	F	G
079	Polysar	Service Water	Aug. 2	W	C
080	Polysar	Stereo API	Aug. 2	F	C
081	Polysar	66" Sewer	Aug. 2	F	C
082	Polysar	72" Sewer	Aug. 2	F	C
083	Polysar	54" Sewer	Aug. 2	F	C
084	Polysar	Ditch In	Aug. 2	D	G
085	Polysar	Ditch Out	Aug. 2	D	C
086	Dow	Service Water	Aug. 15	W	G
087	Dow	Acid Tile Drain	Aug. 15	F	G
088	Dow	42" Sewer	Aug. 15	F	G
089	Dow	48" Sewer	Aug. 15	F	G
090	Dow	54" Sewer	Aug. 15	F	G
091	Dow	3rd St. Sewer	Aug. 15	F	G
093	Polysar	Styrene II	Aug. 16	P	G
094	Polysar	Stereo API	Aug. 16	F	G
095	Sun Oil	Service Water	Aug. 16	W	G
096	Sun Oil	Final	Aug. 16	F	G
097	Sun Oil	Raw	Aug. 16	P	G
098	Sun Oil	Treated	Aug. 16	P	G
099	Ethyl	Final	Aug. 21	F	G
0100	Ethyl	Neutralization Pit	Aug. 21	P	G
0101	IOEL	Service Water	Aug. 21	W	G
0102	IOEL	Raw	Aug. 21	P	G
0103	IOEL	Final (Comp.)	Aug. 21	F	G
0104	Point Edward WPCP	Final	Aug. 22	F	G
0105	Corunna WPCP	Final	Aug. 22	F	G
0106	ESSO Chemical	Raw	Aug. 22	P	G
0107	ESSO Chemical	Dual Media Filter	Aug. 22	P	G
0108	ESSO Chemical	A/C Filter	Aug. 22	P	G
0109	ESSO Chemical	Final	Aug. 22	F	G
0110	Shell Oil	Service Water	Aug. 23	W	G

Table A1 (cont.). Samples collected in 1979 listed by sample number.

Sample Number	Company	Sample site	Date	Type [1]	Method [2]
0111	Shell Oil	Final (Comp.)	Aug. 23	F	G
0112	C.I.L.	Service Water	Aug. 23	W	G
0113	C.I.L.	Final	Aug. 23	F	G
0114	Dupont	Service Water	Aug. 23	W	G
0115	Dupont	Final	Aug. 23	F	G
0116	Polysar	Styrene II	Aug. 24	P	G
0117	Ethyl	Neutralization Pit	Aug. 27	P	G
0118	Ethyl	Final	Aug. 27	F	G
0119	C.I.L.	Service Water	Aug. 28	W	G
0120	C.I.L.	Final	Aug. 28	F	G
0121	Dupont	Service Water	Aug. 28	W	G
0122	Dupont	Final	Aug. 28	F	G
0123	Shell Oil	Service Water	Aug. 29	W	G
0124	Shell Oil	Final (Comp.)	Aug. 29	F	G
0125	Township Ditch	Scott Rd. Ditch 1000	Aug. 29	D	G
0126	IOEL	Drainage	Aug. 29	F	G
0127	Township Ditch	Scott Rd. Ditch 1030	Aug. 29	D	G
0128	Fiberglas	Disposal	Aug. 29	F	G
0129	Township Ditch	SRD Above Fiberglas	Aug. 29	D	G
0130	Holmes Insulation	Final	Aug. 29	F	G
0131	Township Ditch	At RR Tracks	Aug. 29	D	G
0132	Petrosar	Service Water	Aug. 29	W	G
0133	Petrosar	Final	Aug. 29	F	G
0134	Petrosar	DAF	Aug. 29	P	G
0135	Petrosar	A/C Filter	Aug. 29	P	G
0136	Petrosar	Biox. Unit	Aug. 29	P	G
0137	Dupont	Final	Aug. 30	F	G
0138	Fiberglas	Final	Aug. 30	F	G
0139	Cabot Carbon	Final	Aug. 30	F	G
0140	Dow	42" Sewer	Sept. 5	F	G
0143	Sarnia WPCP	Final	Sept. 5	F	G
0144	Holmes Insulation	Final	Sept. 5	F	G
0145	Township Ditch	SRD Above Fiberglas	Sept. 5	D	G
0146	Fiberglas	Disposal	Sept. 5	F	G
0147	Township Ditch	Scott Rd. Ditch 1700	Sept. 5	D	G
0148	Township Ditch	Scott Rd. Ditch 1730	Sept. 5	D	G
0152	Ethyl	Final	Oct. 24	F	G
0153	ESSO Chemical	Raw	Oct. 24	P	G
0154	ESSO Chemical	Dual Media Filter	Oct. 24	P	G
0155	ESSO Chemical	A/C Filter	Oct. 24	P	G
0156	ESSO Chemical	Final	Oct. 24	F	G

Table A1 (cont.). Samples collected in 1979 listed by sample number.

Sample Number	Company	Sample site	Date	Type [1]	Method [2]
0157	Sun Oil	Final	Oct. 29	F	G
0158	Petrosar	DAF	Oct. 29	P	G
0159	Petrosar	Biox. Unit	Oct. 29	P	G
0160	Petrosar	A/C Filter	Oct. 29	P	G
0161	Petrosar	Final	Oct. 29	F	G

1. W = service water, F = final discharge, D = Township ditch
   P = inplant/process stream
2. C = 24H composite, G = grab

Table A2. Samples collected in 1980 listed by sample number.

Sample Number	Company	Sample Site	Date	Type [1]	Method [2]
E1	Ethyl	Service Water	July 16-22	W	C
E2	Ethyl	Service Water	July 23-29	W	C
E3	Ethyl	Final	July 16-22	F	C
E4	Ethyl	Final	July 23-29	F	C
E5	Ethyl	Final	July 30 - Aug. 5	F	C
E6	Ethyl	Service Water	July 30 - Aug. 5	W	C
E7	ESSO Chemical	Service Water	July 29 - Aug. 2	W	C
E8	ESSO Chemical	Service Water	Aug. 3-7	W	C
E9	ESSO Chemical	Final	July 29 - Aug. 2	F	C
E10	ESSO Chemical	Final	Aug. 3-7	F	C
E11	ESSO Chemical	Service Water	Aug. 8-12	W	C
E12	ESSO Chemical	Service Water	Aug. 13-17	W	C
E13	ESSO Chemical	Service Water	Aug. 18-22	W	C
E14	ESSO Chemical	Final	Aug. 8-12	F	C
E15	ESSO Chemical	Final	Aug. 13-17	F	C
E16	ESSO Chemical	Final	Aug. 18-22	F	C
E17	Dow	Service Water	Aug. 6-10	W	C
E18	Dow	Service Water	Aug. 11-15	W	C
E19	Dow	Service Water	Aug. 16-20	W	C
E20	Dow	3rd St. Sewer	Aug. 6-10	F	C
E21	Dow	3rd St. Sewer	Aug. 11-15	F	C
E22	Dow	3rd St. Sewer	Aug. 16-20	F	C
E23	Polysar	Service Water	Aug. 12-16	W	C
E24	Polysar	Service Water	Aug. 17-21	W	C
E25	Polysar	Ditch In	Aug. 12-16	D	C
E26	Polysar	Ditch In	Aug. 17-21	D	C
E27	Polysar	Ditch Out	Aug. 12-16	D	C
E28	Polysar	Ditch Out	Aug. 17-21	D	C
E29	Ethyl	Service Water	Aug. 6-12	W	C
E30	Ethyl	Service Water	Aug. 13-19	W	C
E31	Ethyl	Final	Aug. 6-12	F	C
E32	Ethyl	Final	Aug. 13-19	F	C
E33	Ethyl	Service Water	Aug. 20-26	W	C
E34	Ethyl	Final	Aug. 20-26	F	C
E35	ESSO Chemical	Service Water	Aug. 23-27	W	C
E36	ESSO Chemical	Final	Aug. 23-27	F	C
E37	Dow	Service Water	Aug. 21-25	W	C
E38	Dow	Service Water	Aug. 26-30	W	C
E39	Dow	Service Water	Aug. 31 - Sept. 4	W	C
E40	Dow	3rd St. Sewer	Aug. 21-25	F	C
E41	Dow	3rd St. Sewer	Aug. 26-30	F	C
E42	Dow	3rd St. Sewer	Aug. 31 - Sept. 4	F	C
E43	Polysar	Service Water	Aug. 22-26	W	C
E44	Polysar	Service Water	Aug. 27-31	W	C
E45	Polysar	Ditch In	Aug. 22-26	D	C
E46	Polysar	Ditch In	Aug. 27-31	D	C
E47	Polysar	Ditch Out	Aug. 22-26	D	C
E48	Polysar	Ditch Out	Aug. 27-31	D	C

Table A2(cont.). Samples collected in 1980 listed by sample number.

Sample Number	Company	Sample Site	Date	Type [1]	Method [2]
E49	Petrosar	Chemical DAF	Sept. 6	P	C
E50	Petrosar	Oily DAF	Sept. 6	P	C
E51	Petrosar	Biox. Unit	Sept. 6	P	C
E52	Petrosar	A/C Filter	Sept. 6	P	C
E53	Petrosar	Final	Sept. 6	F	C
E54	Petrosar	Service Water	Sept. 6	W	C
E55	Petrosar	Chemical DAF	Sept. 7	P	C
E56	Petrosar	Oily DAF	Sept. 7	P	C
E57	Petrosar	Biox. Unit	Sept. 7	P	C
E58	Petrosar	A/C Filter	Sept. 7	P	C
E59	Petrosar	Final	Sept. 7	F	C
E60	Petrosar	Chemical DAF	Sept. 8	P	C
E61	Petrosar	Oily DAF	Sept. 8	P	C
E62	Petrosar	Biox. Unit	Sept. 8	P	C
E63	Petrosar	A/C Filter	Sept. 8	P	C
E64	Petrosar	Chemical DAF	Sept. 9	P	C
E65	Petrosar	Oily DAF	Sept. 9	P	C
E66	Petrosar	Biox. Unit	Sept. 9	P	C
E67	Petrosar	A/C Filter	Sept. 9	P	C
E68	Petrosar	Final	Sept. 9	F	C
E69	Petrosar	Service Water	Sept. 9	W	C
E70	Petrosar	Chemical DAF	Sept. 10	P	C
E71	Petrosar	Oily DAF	Sept. 10	P	C
E72	Petrosar	Biox. Unit	Sept. 10	P	C
E73	Petrosar	A/C Filter	Sept. 10	P	C
E74	Petrosar	Chemical DAF	Sept. 11	P	C
E75	Petrosar	Oily DAF	Sept. 11	P	C
E76	Petrosar	Biox. Unit	Sept. 11	P	C
E77	Petrosar	A/C Filter	Sept. 11	P	C
E78	Petrosar	Final	Sept. 11	F	C
E79	Petrosar	Chemical DAF	Sept. 12	P	C
E80	Petrosar	Oily DAF	Sept. 12	P	C
E81	Petrosar	Biox. Unit	Sept. 12	P	C
E82	Petrosar	A/C Filter	Sept. 12	P	C
E83	Petrosar	Chemical DAF	Sept. 13	P	C
E84	Petrosar	Oily DAF	Sept. 13	P	C
E85	Petrosar	Biox. Unit	Sept. 13	P	C
E86	Petrosar	A/C Filter	Sept. 13	P	C
E87	Petrosar	Service Water	Sept. 13	W	C
E88	Petrosar	Chemical DAF	Sept. 14	P	C
E89	Petrosar	Oily DAF	Sept. 14	P	C
E90	Petrosar	Biox. Unit	Sept. 14	P	C
E91	Petrosar	A/C Filter	Sept. 14	P	C
E92	Petrosar	Final	Sept. 14	F	C

1. W = service water, F = final discharge, D = Township ditch
   P = inplant/process stream
2. C = composite, G = grab

APPENDIX B

DETAILED POINT SOURCE DESCRIPTIONS

APPENDIX B

DETAILED POINT SOURCE DESCRIPTIONS

B:1.0 Industrial Facilities

B:1.1 Imperial Oil Enterprises Limited (IOEL)

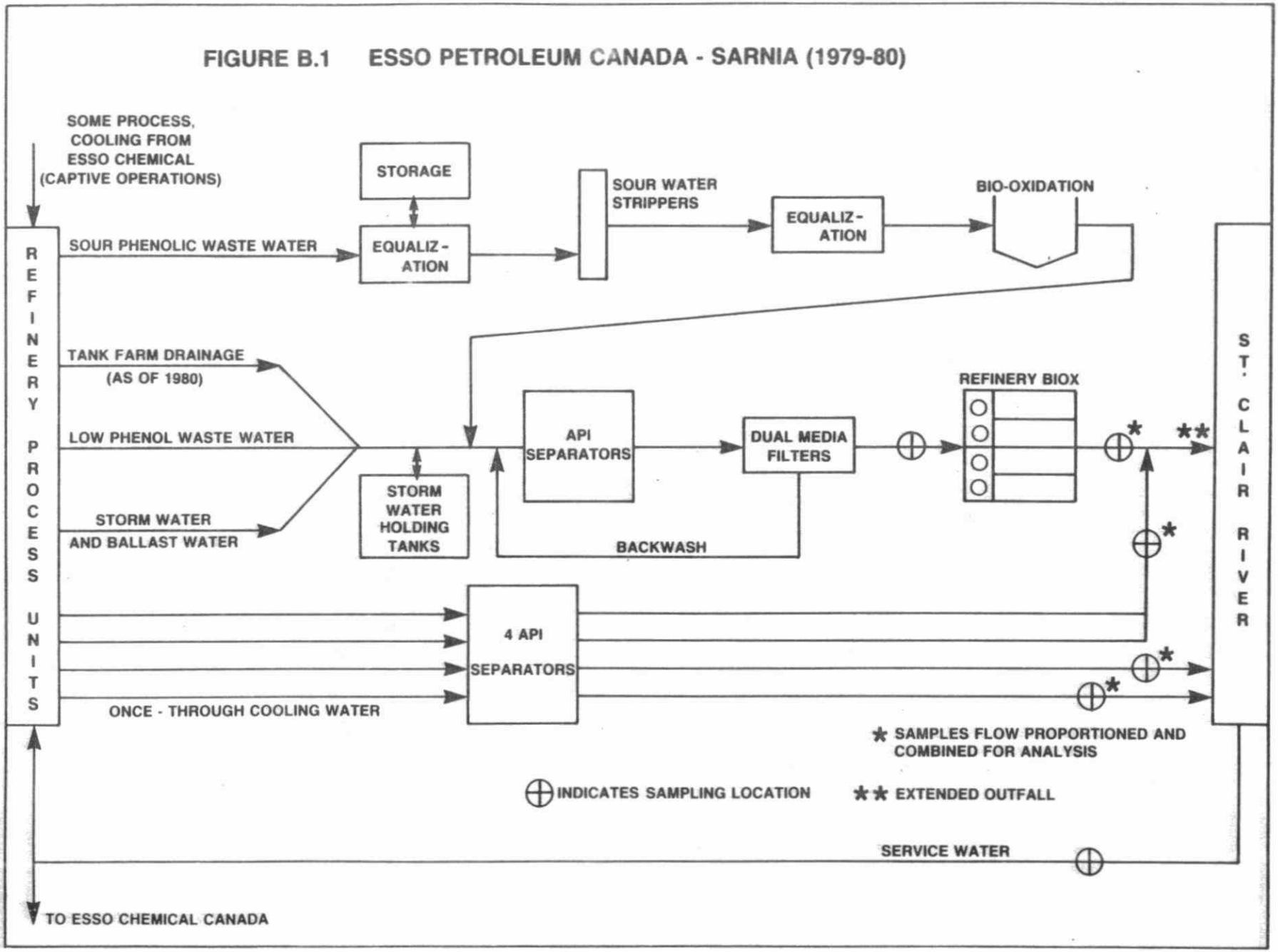
The Sarnia Refinery of Imperial Oil Limited (now managed by Esso Petroleum Canada, a division of Imperial Oil) processes crude oil into gasolines, stove oils, diesel fuels, jet fuels, homeheating oils, lubricating oil, waxes, sulphur, asphalts, and liquefied-petroleum gases. In addition, there are a small number of petrochemical operations which are integrated with the refinery. The petrochemical operations are managed by Esso Chemical Canada, but they utilize the refinery cooling and wastewater systems. The petrochemical operations include facilities to produce olefins, solvents and lubricant additives.

These comments apply to the refinery water systems which serve the refinery and a small number of petrochemical operations.

The cooling water streams are segregated from the oil-contacting water streams. Once through cooling water (OTCW) is treated to remove oil through four parallel API separators, before discharging to the St. Clair River (Figure B:1).

The oil-contacting water streams are extensively treated before release. Sour waters are steam stripped of hydrogen sulphide and ammonia and biologically treated to remove phenolics before combining with other process water. Stormwater, tank farm runoff (since 1980) and process water pass through three parallel API separators before filtration through a dual-media filter. The filter effluent discharges to the refinery activated sludge plant (Biox). The final effluent combines with OTCW from two of the API separators and discharges to the river.

FIGURE B.1 ESSO PETROLEUM CANADA - SARNIA (1979-80)



Grab samples of the service water, Biox influent, Biox effluent and final effluent (flow proportioned sample composed of OTCW and Biox effluent) were taken on July 25, August 2 and August 21, 1979. The final combined effluent sample was 6-9% process water (Biox effluent) and 91-94% OTCW depending on the flows of OTCW and Biox effluent on the day of sampling. The total combined flows during each day of sampling were 212, 208 and 220 x $10^3 m^3/d$ respectively.

Grab samples were collected from three stations in 1979. The unfiltered wastewater prior to the sand filter, the activated carbon filter effluent and the final discharge to the river were sampled three times each on July 25, August 2, and October 24, 1979. The average final effluent flow on or near these sampling dates was 10.4 x $10^3 m^3/d$.

In 1980, Esso Chemical was surveyed more intensively over six 5-day periods. Twenty-four hour composite samples of the service water and the final effluent were collected and composited for each 5-day period. Composite samples for July 29-August 2, August 3-7, August 8-12, August 13-17, August 18-22, and August 23-27, 1980 were submitted for organics analysis.

B:1.2 Esso Chemical Canada (ECC)

Esso Chemical Canada is a division of Imperial Oil Enterprises Limited. ECC manages and operates petrochemical manufacturing facilities at Sarnia. Many of the ECC operations are integrated with the petroleum refinery operated by Esso Petroleum Canada. An independent Esso Chemical plant is located east of the Esso refinery. It has its own cooling and wastewater system. These comments will apply only to the non-integrated Esso Chemical plant.

At the time of the survey, the ECC wastewater system served operations producing polyvinylchloride resins and aromatics (benzene, toluene and xylene), as well as a chemical products cracking unit which was shut down in mid 1983. In August 1983, a new polyethylene resins plant was started up. The plastics plants are based primarily on ethylene derived from natural gas liquids.

Esso Chemical's process and contaminated cooling wastewaters discharge to one of two circular oily water separators. From the separators, the combined effluent discharges through a two-stage filtration (sand followed by activated carbon). The treated effluent discharges to the clean water impounding basin. When flow during heavy rain exceeds the capacity of the dual media filters and carbon adsorber system excess water is diverted to the oily impounding basin and held until it can be brought back through the filter and carbon treaters under control. The oily water impounding basin is, therefore, a hold-up facility only. When the TOC (Total Organic Carbon) analyzer on the effluent from the Aromatics Plant shows unacceptable hydrocarbon levels, the effluent is diverted to the oily impounding basin and brought back under controlled rate. Uncontaminated once-through cooling water also discharges into this last basin and the combined effluent discharges to the St. Clair River. The service water is obtained from the St. Clair river (Figure B.2).

B:1.3 Polysar Limited

Polysar manufactures synthetic rubbers (SBR, nitrile, BR, butyl and halobutyl) and rubber latex. It also produces many of the chemical intermediates for use at the Sarnia site. This includes the production of benzene, ethylbenzene, styrene, butadiene and isobutylene. Polysar has four sewer discharges to the St. Clair River (54", 66", 72" sewers and stereo API sewer) and several cooling water and stormwater discharges to the Township Ditch. The research and development (R and D) laboratory also discharges to the Township Ditch (see Figure B.3).

FIGURE B.2 ESSO CHEMICAL CANADA - SARNIA (1979-80)

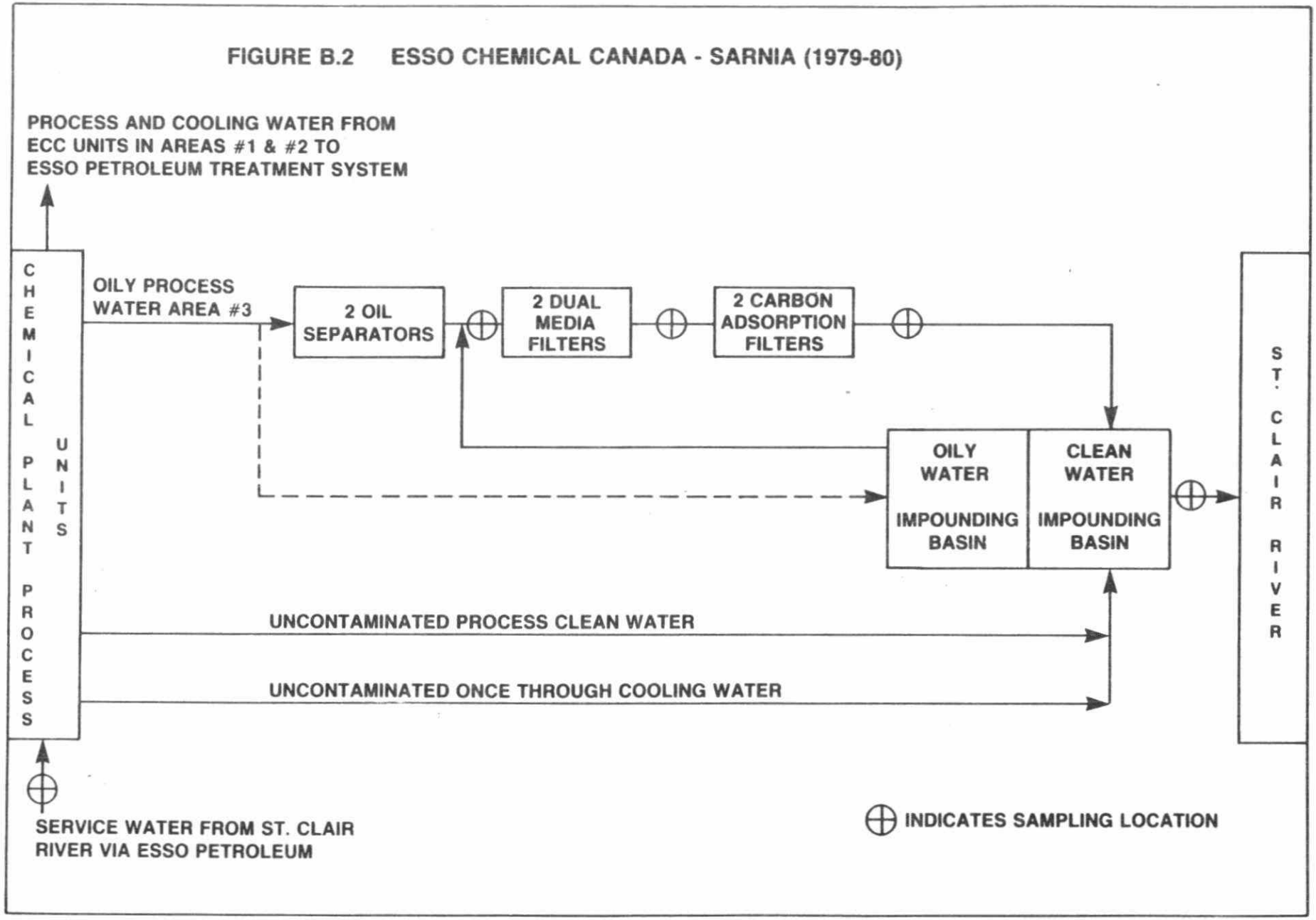
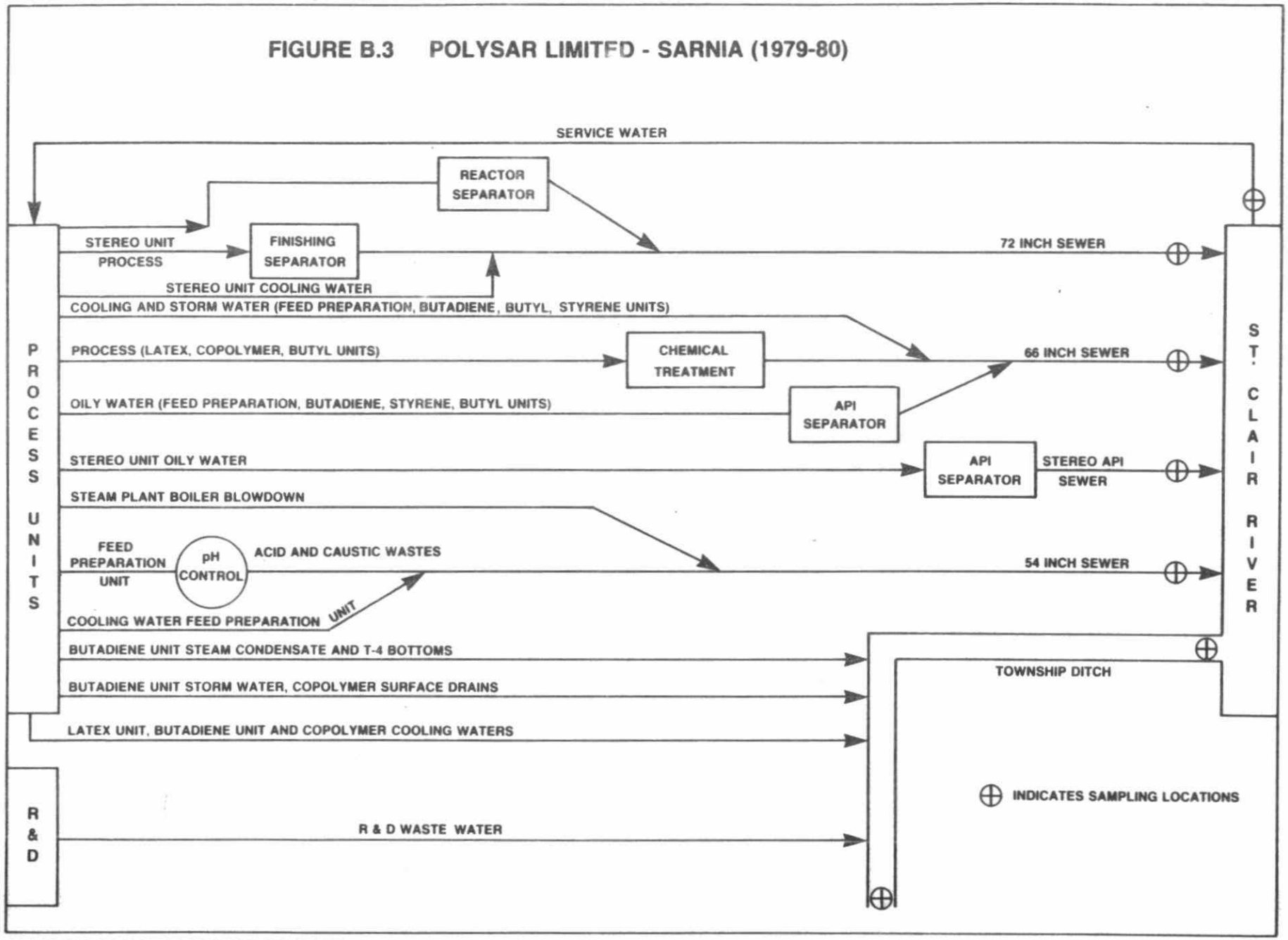


FIGURE B.3 POLYSAR LIMITED - SARNIA (1979-80)



SEE FIGURE B.11 FOR LOCATION OF "STYRENE II" SAMPLING STATION

Oily water from the Stereo Unit (Polybutadiene production) is treated in an oily water separator prior to discharging to the river. The average flow to the river during June-August 1979 was 3 x 10^3 m^3/d (Stereo API sewer)

The 54" sewer outfall contains cooling water from the feed preparation unit, boiler blowdown from the Steam Plant and treated (pH control) caustic and acid waste. The average flow during the June-August 1979 period was 55 x 10^3 m^3/d. Oily water from the two process areas within the Feed Preparation Unit (Isobutylene extraction and Butylene concentration areas) is discharged to an oil separator and subsequently to the 66" sewer.

The 66" sewer is the major process sewer and it services the largest area of the plant. Storm water from the Feed Preparation, Butyl and Butadiene Units discharge to this sewer. Process wastewater from the Styrene Unit receives separate chemical treatment before entering the main oil separator while process wastes from the Latex Unit, Copolymer Unit and Butyl Unit are collected and treated together by coagulation, screening, chemical flocculation and filtration. Oily waters from the Feed Preparation Unit, Butadiene Unit and Butyl Unit pass through oily water separators before discharge to the 66" sewer. The Styrene Unit also has an oily water separator. The average flow at the outfall during June-August 1979 was 270 x 10^3 m^3/d.

The 72" sewer receives mainly cooling water from the Stereo Unit as well as high solids wastewater which has passed through a solids separator. The average flow during the June to August 1979 period was 22 x 10^3 m^3/d.

Polysar takes its service water from the St. Clair River just downstream of the outfall of the Township ditch. Since 1983 a

new biological treatment plant has come on line for the treatment of organic laden process wastewaters. The installation of this plant was brought about under a Ministry of the Environment Control Order.

The Polysar service water, Stereo API sewer, 66" sewer, 54" sewer and 72" sewer were sampled June 12, June 27 and August 2, 1979.

In 1980, the two sampling sites in the Township Ditch bordering Polysar (Ditch-In, Ditch-Out) were sampled intensively over four 5-day periods. Twenty-four hour composite samples were collected daily and composited over five days for organics analysis (August 12-16, August 17-21, August 22-26, August 27-31, 1980).

B:1.4 Dow Chemical of Canada Limited

Dow Chemical operates a diversified chemical/plastics complex in Sarnia composed of 21 specific manufacturing plants. The product line includes styrene, polystyrene, propylene glycol, chlorine and caustic soda, methylchloride, chlorinated solvents, latexes, vinyl chloride, high density polyethylene and expandable polystyrene foam. The complex has nine discharges to the St. Clair River and two service water intakes. The sewers and their approximate flows are listed below. The majority of the water used is for OTCW. Other uses are equipment washing, steam production and direct contact with products/raw materials.

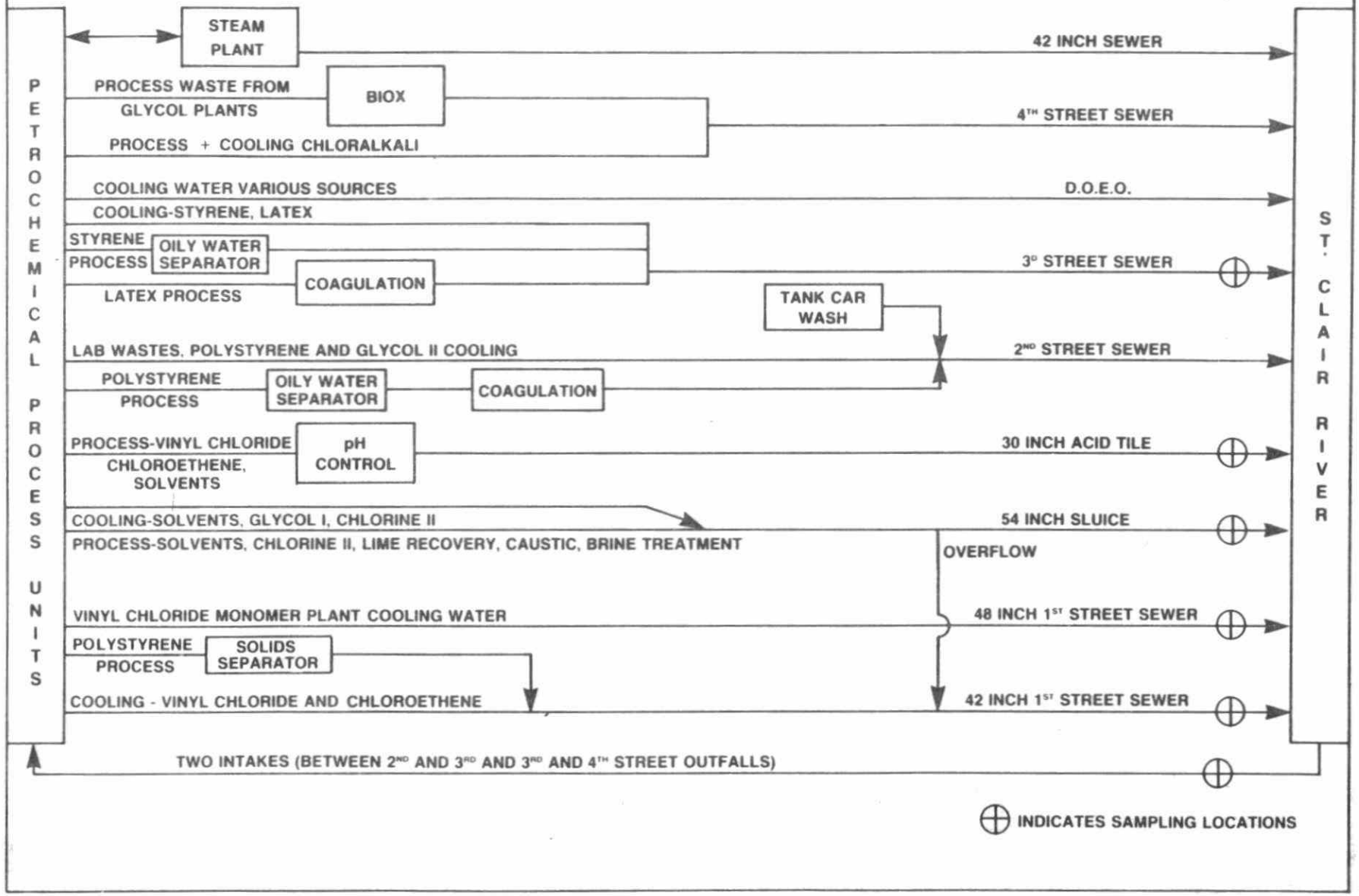
Sewer Identification	Average Flow (1980) 10^3 m^3/d
1. 42" 1st Street Sewer	60
2. 48" 1st Street Sewer	74
3. 1st Street Acid Tile Drain	10
4. 54" Sluice	35
5. 2nd Street Sewer	58
6. 3rd Street Sewer	100
7. Dominion Alloy Sewer (D.O.E.O.)	160
8. 4th Street Sewer	310
9. 42" & 12" Steam Plant Sewers	13

The 42" 1st Street Sewer receives process wastewater and/or cooling water from the vinyl chloride monomer, chloroethene and expandable polystyrene plants, and overflow from the solvents and Glycol I plants (cooling water only). Gas scrubber waste from vinyl chloride receives pH control. The 48" 1st Street Sewer receives exclusively cooling water from the vinyl chloride monomer plant (see Figure B.4).

The 1st Street Acid Tile Drain receives process water and cooling water from the vinyl chloride, chloroethene and solvents plants. The 54" Sluice receives the bulk of process and cooling water from the solvents, ethanolamines, glycol (cooling water only) brine treatment, chlorine and caustic plants. The 2nd Street sewer receives laboratory wastes, polystyrene process effluent which has been treated by an oil separator and coagulation, tank car wash area runoff and cooling water from the Glycol II plant. Process wastewater from Glycol I and II discharge to the biological treatment plant.

The 3rd Street sewer receives process and cooling water from the styrene (oil separator), latex (coagulation), and polyethylene (solids separators) plants. The D.O.E.O sewer

FIGURE B.4 DOW CHEMICAL OF CANADA LTD. - SARNIA (1979-80)



receives cooling water ftom several sources and process/cooling effluent from the ethylene oxide plant. This process was shut down in 1984.

The 4th Street sewer receives the biological treatment plant effluent and process and cooling water from the chlor-alkali I plant as well as supernatant from several settling ponds. Only the 42", 48", 54" sluice, acid tile and 3rd Street sewers were sampled in 1979/80. Grab samples were collected June 20, July 18 and August 15, 1979. The service water was also sampled on these dates.

In 1980, the service water and the 3rd Street sewer were surveyed intensively over six 5-day periods in August. Twenty-four hour composite samples were collected daily and composited into 5-day samples for organics analysis. The 5-day periods were August 6-10, August 11-15, August 16-20, August 21-25, August 26-30 and August 31-September 4, 1980.

B:1.5 Sun Oil (Sunoco Incorporated)

The Sunoco Refinery converts crude oil from Western Canada into gasolines, kerosene, jet fuel, heating oils, heavy fuel oils, aromatics such as benzene, sulphur and light hydrocarbon gases and liquids. The refinery has a single outfall to the river composed of treated OTCW, stormwater runoff and process wastewater. The total annual average flow in 1980 was 104 x $10^3 m^3/d$.

Sour process waters are stripped to remove hydrogen sulphide and ammonia and spent caustic is neutralized. The effluent from these treatment processes combines with other oily process water and passes through an API separator to remove oil. Dissolved air

floatation (DAF) is then applied to remove fine oil droplets suspended in the effluent. Following equalization, the effluent is treated biologically in an aeration basin to remove phenolics and other biodegradeable compounds. Following final clarification, the effluent discharges to an impounding basin(see Figure B.5).

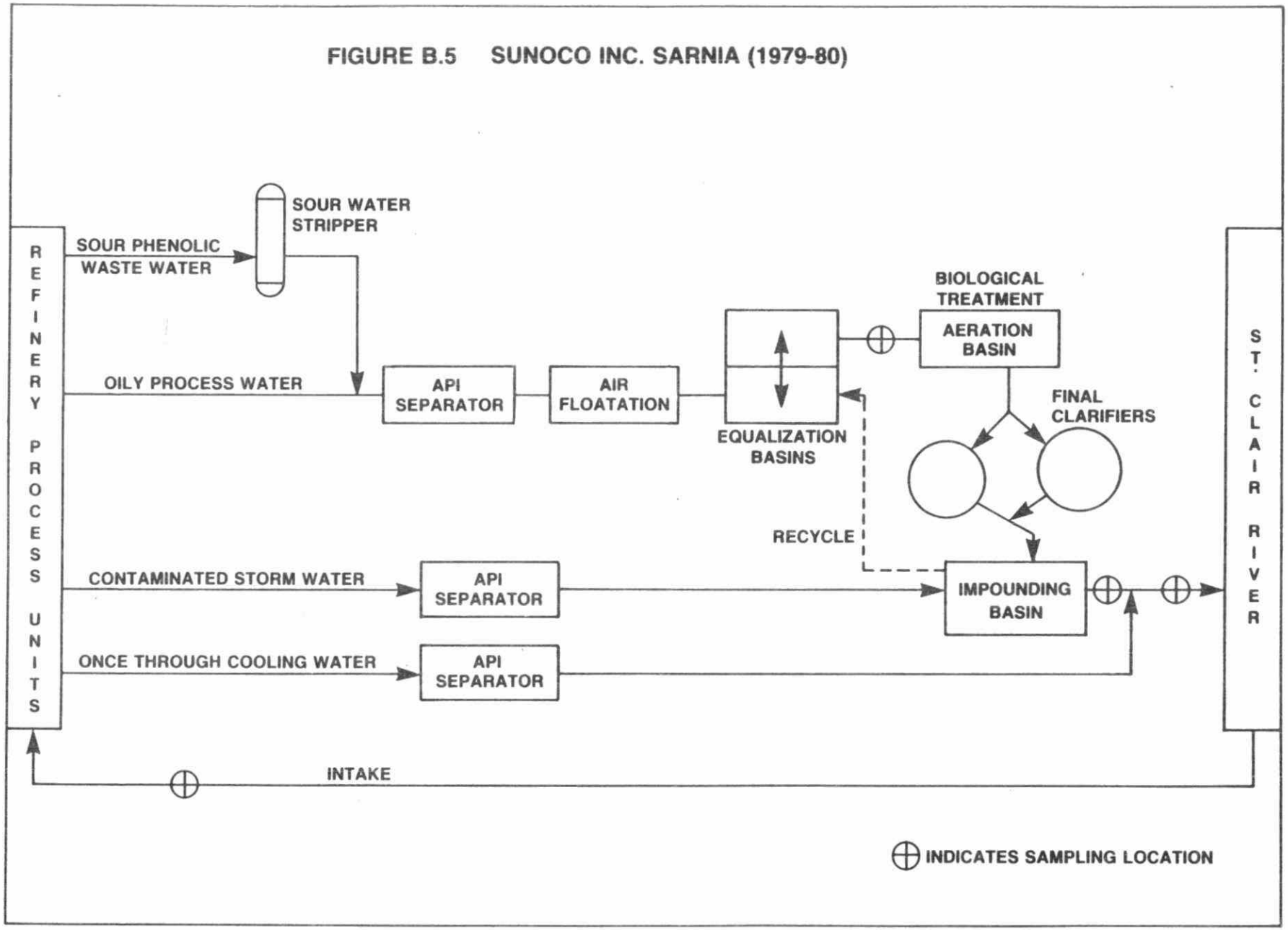
Contaminated stormwater is collected and treated for oil removal through an API separator which also discharges to the impounding basin. The impounding basin overflow combines with OTCW, which has passed through an API separator, and discharges via a single outfall to the river. In the case of an upset, the impounding basin contents can be recycled through the process treatment system, entering at the equalization basins.

Sunoco was surveyed in 1979 only. Grab samples of the service water (intake), aeration basin influent, impounding basin effluent and final combined effluent were taken on June 21, July 17 and August 16, 1979. An additional grab sample of the final combined effluent was collected on October 29, 1979. The average monthly flows for June, July and August 1979 were 127, 127 and 124 x $10^3 m^3/d$, which are about 20% higher than the 1980 annual average. Summer cooling water flows may be higher due to warmer ambient river temperatures.

B:1.6 Shell Oil (Shell Canada Ltd.)

The Shell Canada Limited refinery at Corunna processes western crude oil into automotive gasolines, aromatic and aliphatic solvents, stove oil, diesel fuel, home heating oil, bunker fuel, fuel gas, propane, butane, butylenes and liquid sulphur. The refinery has two outfalls to Talford Creek just upstream of the St. Clair River. The clean water effluent is composed of uncontaminated

FIGURE B.5 SUNOCO INC. SARNIA (1979-80)

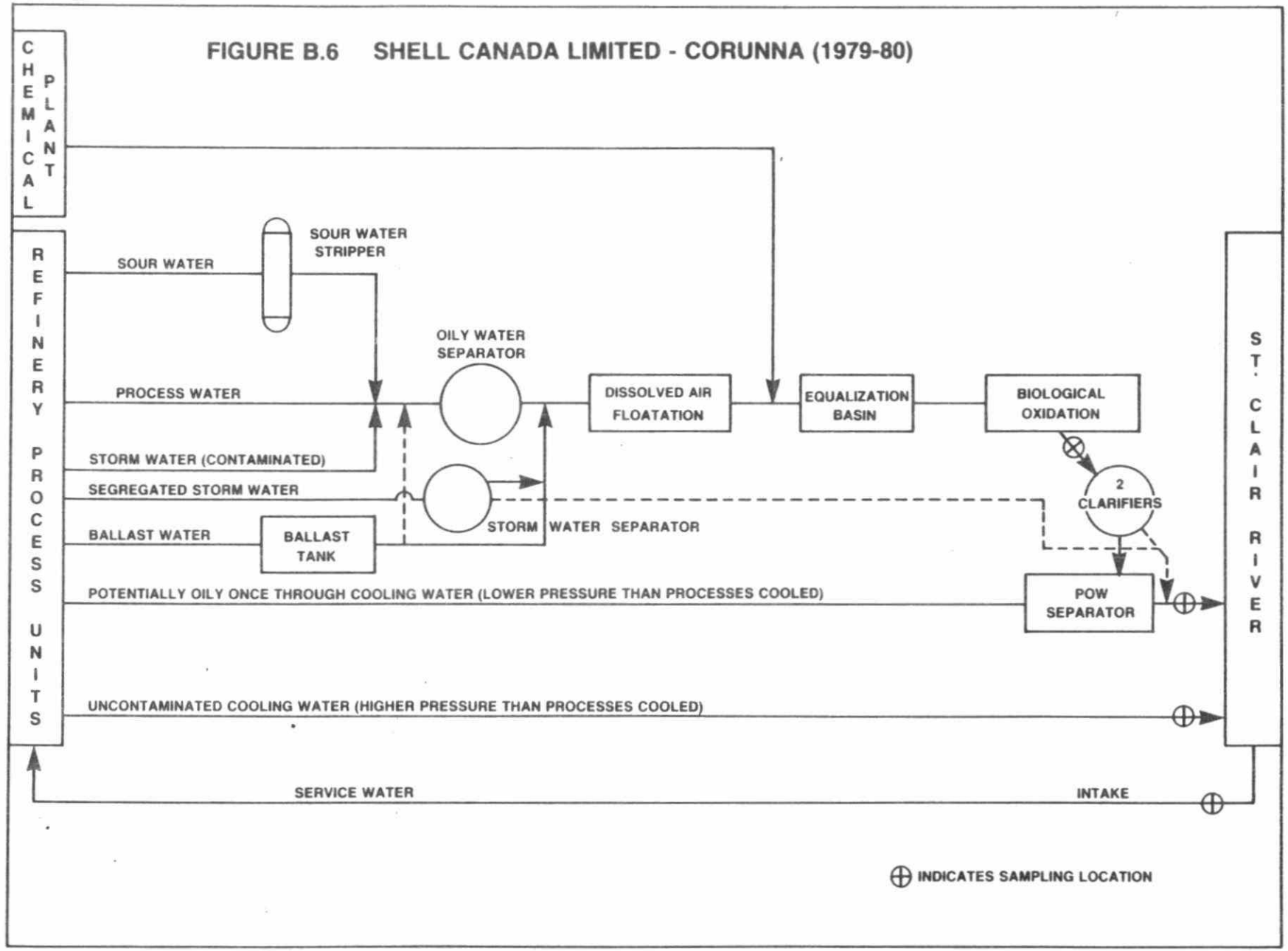


OTCW. This stream is unlikely to be contaminated because it cools equipment where the process unit pressure is lower than that of the cooling water. Thus leaks would tend to flow into the process. The second outfall, from the potentially oily water separator, contains OTCW which could be contaminated by leaks in process equipment, biological treatment plant (Biox) effluent and stormwater overflow. The annual average flows for the process (Biotreated) effluent and the total cooling water streams used in the refinery were 9.8 x $10^3 m^3/d$ and 242 x $10^3 m^3/d$ respectively in 1980 (see Figure B.6).

The uncontaminated once-through-cooling water is discharged directly to Talford Creek. Potentially oily OTCW discharges to the POW separator. Sour water is stripped to remove ammonia and hydrogen sulphide and then joins other process water and contaminated stormwater before discharging to an oily water separator where oil is removed. Ballast water from freighters generally combines with the separator effluent, however if it is excessively contaminated it can be redirected through the separator. Segregated stormwater is treated in a stormwater separator. The overflow from the separator can discharge either to the POW separator effluent or to the process oily water separator effluent prior to its treatment at the air flotation unit.
Following DAF to remove tiny droplets of oil, the effluent combines with wastewater from the Shell Chemical plant and passes into an equalization basin. The equalization basin discharges to the biological oxidation unit where phenolics and other organics are broken down. The Biox effluent flows through two parallel clarifiers and then discharges to the POW separator. Alternatively, the clarifier effluents may bypass the separator. The combined POW cooling water, treated process water and storm water overflow discharge to Talford Creek.

In 1979, grab samples of the Shell service water, Biox effluent, POW cooling water and the combined POW/process/storm (Final) effluent were collected. The service water was collected August 1, 23, and 29. One sample each of the Biox. POW and clean

FIGURE B.6 SHELL CANADA LIMITED - CORUNNA (1979-80)



cooling water effluent were collected on August 1. The combined final effluent was sampled August 23 and 29, 1979. The average flow of the combined effluent for August 1979 was 110 x 10^3 m^3/d.

B:1.7 Ethyl Corporation (Ethyl Canada Inc.)

Ethyl Canada at Corunna produces ethylchloride, ethylene dichloride (EDC), tetramethyl lead (TML), tetraethyl lead (TEL) antiknock compounds, phenolic antioxidants, aluminum alkyls and until 1982, pharmaceuticals. There is a single combined sewer submerged diffuser discharge at the river which is located at the edge of the deeper shipping channel (see Figure B.7).

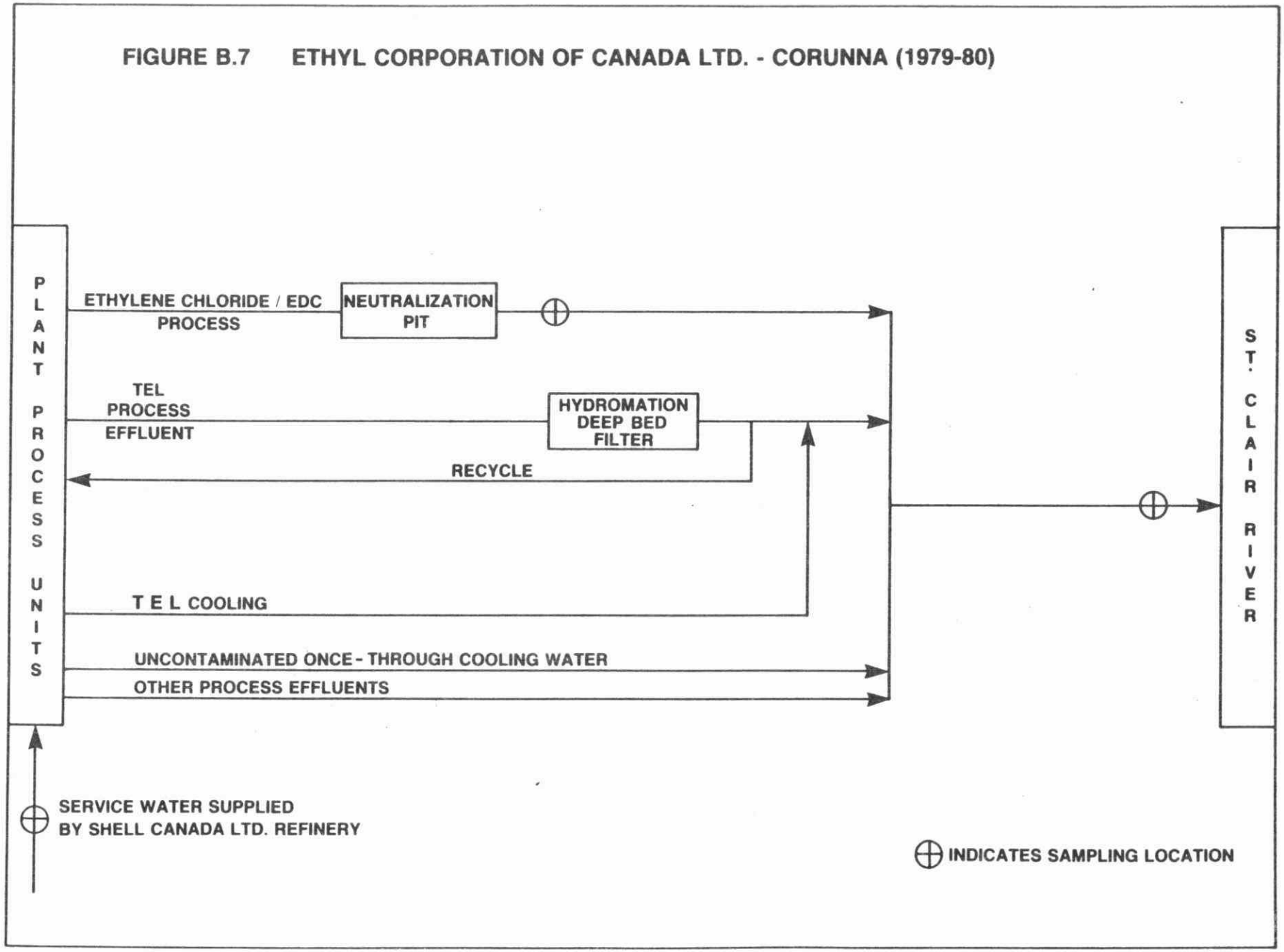
Process effluent from the lead antiknock compound production unit is filtered using a deep bed hydromation filter. The filter effluent is partially recycled and the balance combines with OTCW prior to discharge. Neutralized effluent from the ethylene chloride/EDC unit, and effluents from the other processes join with the TEL plant effluent and are discharged to the river.

Grab samples of the neutralization pit effluent and the final combined effluent were taken on July 31, August 21 and August 27, 1979. In 1980 a more intensive survey was conducted over six 7-day periods. Twenty-four hour composite samples of the service water (supplied by Shell Canada) and the final effluent were collected July 16-22, July 23-29, July 30-August 5, August 6-12, August 13-19 and August 20-26, 1980. The average flow during this period was 42.3 x $10^3 m^3/d$.

B:1.8 Dupont of Canada Ltd.

The Dupont plant at Corunna produces a number of grades of low to high density polyethylene resins, which are used for flexible and

FIGURE B.7 ETHYL CORPORATION OF CANADA LTD. - CORUNNA (1979-80)



rigid applications. There is a single discharge to the St. Clair River which is composed of cooling water and boiler blowdown. Except in the case of a spill or leak, there is no process effluent in the discharge. Cooling water is held in a large holding pond prior to skimming and discharge to the river. Grab samples of the service water were collected July 24, August 23 and August 28, 1979. The final effluent was sampled July 24, August 23, August 28 and August 30. The annual average flow for 1980 was 36.3 x $10^3 m^3/d$ (see Figure B:8).

B:1.9 Petrosar Limited

Petrosar at Corunna is a petrochemical refinery which processes crude oil from Alberta to produce polymer grade ethylene, chemical grade propylene, butadiene, isobutylene, butylene, benzene, toluene, gasoline, No.2 fuel oil, residual fuel oil, synthetic natural gas and liquified petroleum gas.

The wastewater treatment facility is composed of two parallel pre-treatment lines for oily and chemical wastewaters. Off-spec effluent can be recycled back into the system. Spent caustic is first neutralized before combining with sour wastewater and discharging to the sour water stripper to remove sulphide and ammonia. The stripper effluent combines with chemically contaminated process wastewater and discharges to an oil-water separator. The separator effluent flows into an equalization basin and then to the Chemical DAF Unit. A parallel treatment system takes oily water and contaminated stormwater and discharges the combined wastewater through an oily water separator, equalization pond and Oily DAF Unit (see Figure B:9).

The chemical process waste discharges from the Chemical DAF to an aeration basin for biological treatment in the Biox Unit. Following clarification, the chemical stream combines with the oily water stream and is filtered through activated carbon (A/C

FIGURE B.8 DUPONT OF CANADA LTD. - CORUNNA (1979-80)

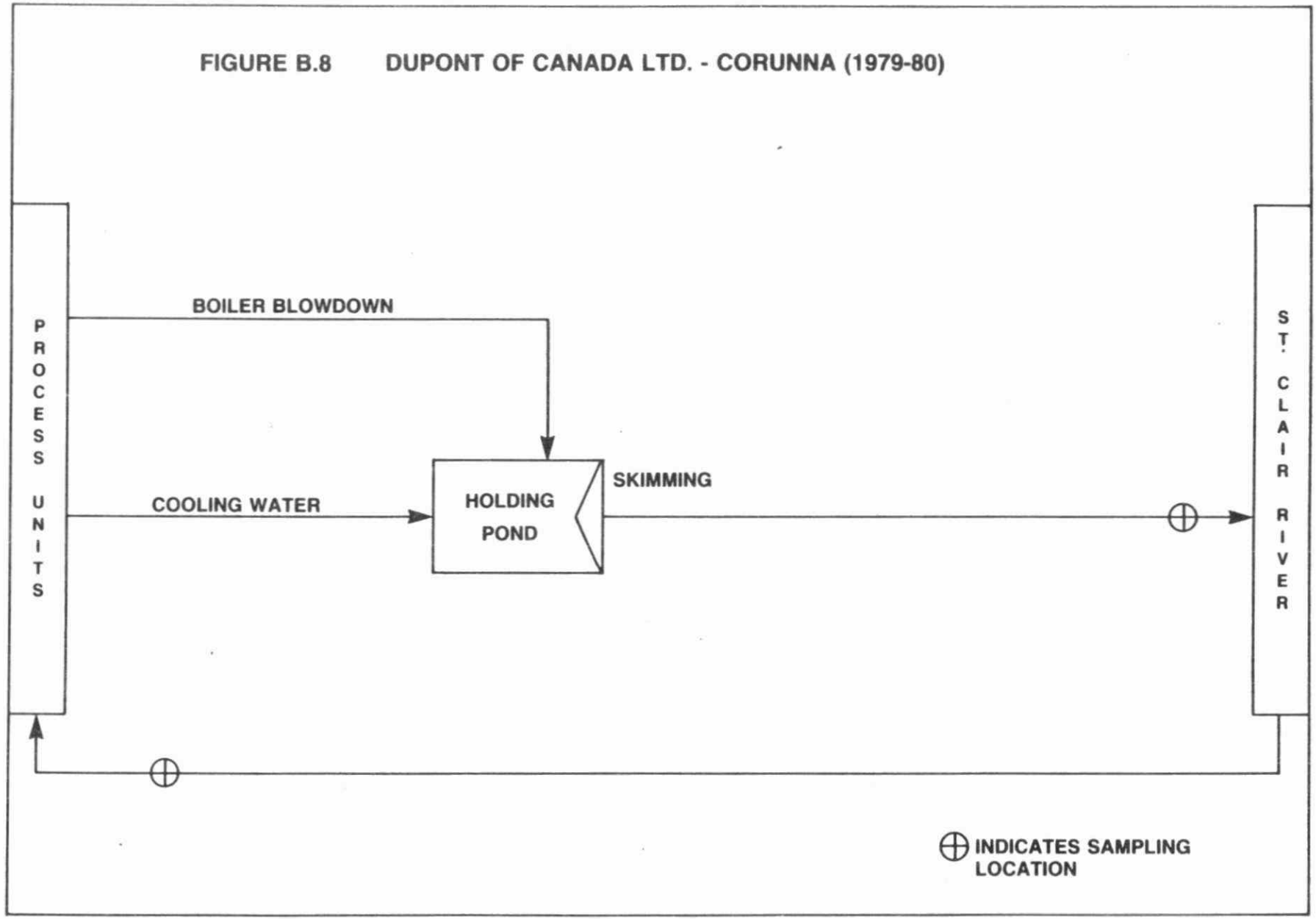
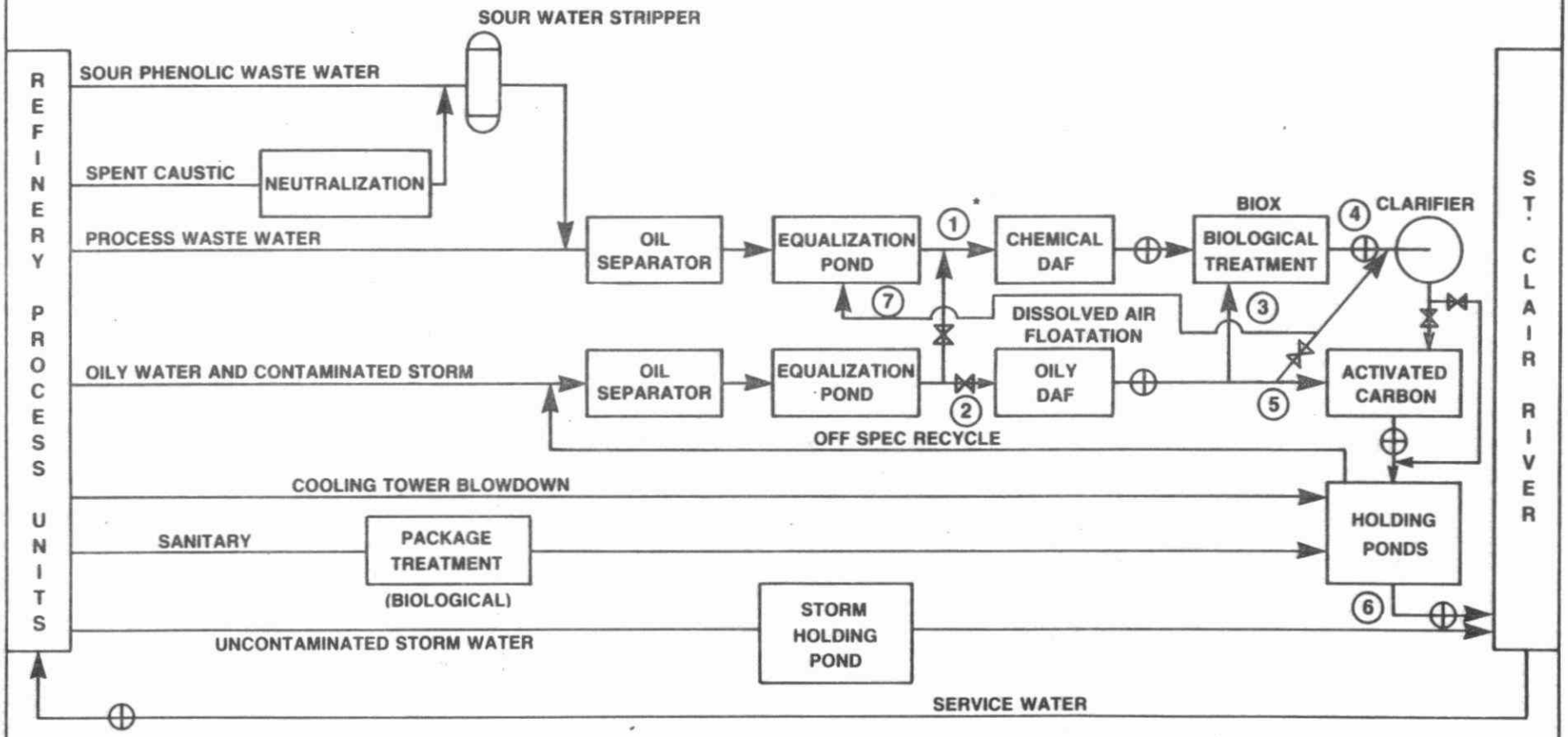


FIGURE B.9 PETROSAR LIMITED - CORUNNA (1979-80)



*NUMBERS INDICATE FLOW MEASUREMENT SITES
(APPENDIX F, TABLE F2)

⊕ INDICATES SAMPLING LOCATION

Filter). The carbon filters discharge to a holding pond from which the final effluent discharges to the river. Cooling tower blowdown and treated (biological) sanitary effluent also discharge to the holding pond. The holding pond contents can be recycled to the oily water separator if the quality is not suitable for discharge. Due to problems with the neutralization of spent caustic, there is sometimes a problem with pH control. Commencing 1982, the final effluent is contained and not discharged when the pH falls outside of the range of 6.0-9.5. Uncontaminated stormwater from non-process areas of the plant property discharge to a stormwater holding pond which overflows to the river.

In 1979, grab samples of the service water, Chemical DAF, Biox Unit effluent, A/C Filter effluent and the Final combined holding pond effluent were collected July 25, July 31, August 29 and October 29 (not service water). The average flow for the four sampling dates was 9.4×10^3 m^3/d. A more intensive survey was conducted in 1980 in which daily grab samples of the Chemical DAF, Oily DAF, Biox Unit, A/C Filter and Final effluent were collected September 6-14. The service water was sampled September 6, 9 and 13, 1980.

B:1.10 Canadian Industries Limited (CIL)

The CIL Lambton Works at Courtright is the largest fertilizer plant in Canada. Anhydrous ammonia, nitrogen solutions, urea, ammonium nitrate, mono-ammonium phosphate, diammonium phosphate, phosphoric and nitric acids and sulphur coated urea are manufactured on-site.

Phosphate fertiizer process water is recycled through settling and cooling ponds to form a closed loop system. Contaminated nitrogen process wastewater is treated prior to combining with

the site cooling water which discharges into the St. Clair River. A surface ditch system, which directs all precipitation into the final effluent, includes an automatically actuated spill contaminant lagoon. Also joining the outfall is the sanitary wastewater which is treated biologically and chemically (Figure B:10).

Grab samples of the final effluent and service water were taken July 26, August 23 and August 28, 1979. The average final effluent flow during this period was approximately 386 x $10^3 m^3/d$.

B:1.11 The Township Ditch

The Township Ditch is a highly branched open ditch system servicing an area south of Sarnia's residential and business core. The drainage system is bounded approximately by the CNR railway track south of Confederation Street on the north, Modeland Road on the east, Churchill Road on the south and the St. Clair River on the west. It receives stormwater runoff from undeveloped and developed land, waste disposal and product storage areas, treated and untreated runoff and industrial effluent and cooling water (Figure B:11).

The first major upstream area of influence is the Scott Road Ditch which serves an industrial waste disposal area. Waste disposal sites along Scott Road are owned by Polysar, Dow Chemical, Fiberglas, Imperial Oil Enterprises (Refinery and Chemical Plant) as well as the City of Sarnia (sewage sludge disposal lagoons). The Scott Road Ditch runs along the western edge of the industrial waste disposal area and receives treated and untreated dump site runoff before joining the Township Ditch which up to this point contains mostly undeveloped area runoff. An open ditch exists along Scott Road from Churchill Road to Imperial Avenue and from there, a

FIGURE B.10 CANADIAN INDUSTRIES LTD. INC. - COURTRIGHT (1979-80)

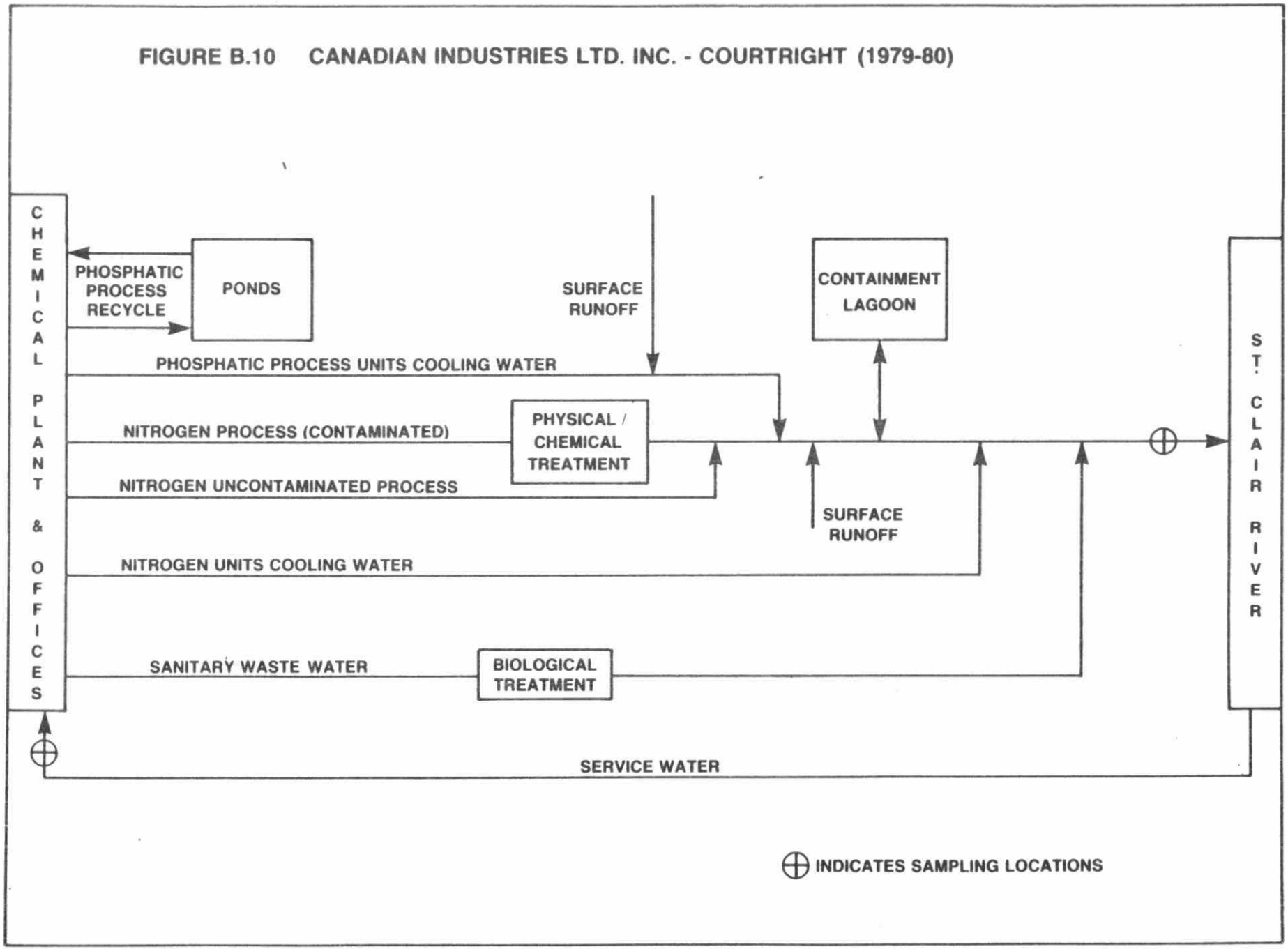
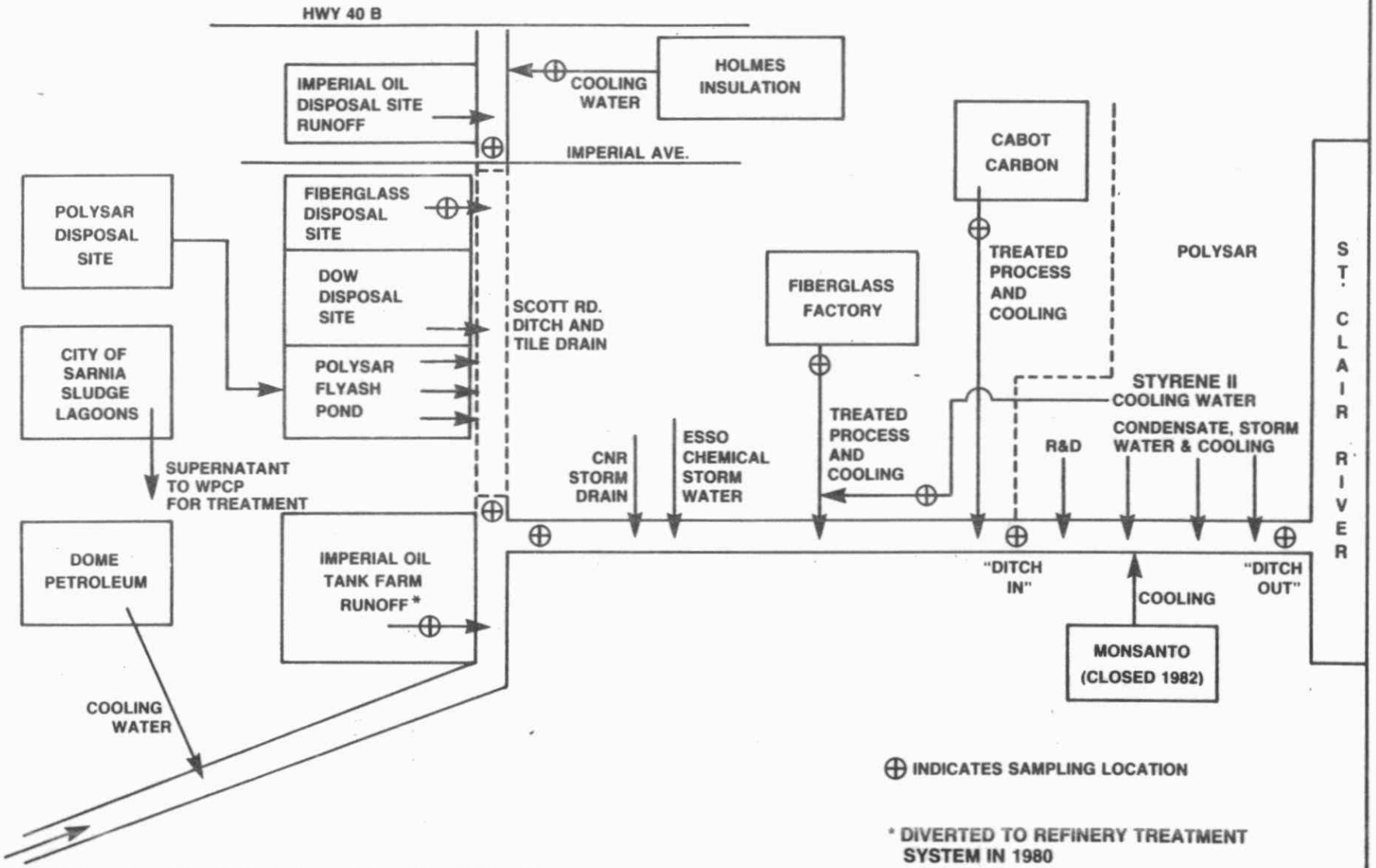


FIGURE B.11 SARNIA TOWNSHIP DITCH (1979-80)



submerged till conveys runoff to the northern edge of Polysar property into the Township Ditch. The Imperial Oil Enterprises waste disposal site located north of Churchill Road is capped and only surface runoff discharges to the ditch. This is no collection system for potential leachate.

The Fiberglas disposal site is north of Imperial's waste disposal site and contains buried waste fiberglass. Bonding resins and dyes were at one time leaching out of this site. The leachate was collected and pumped into a holding lagoon where it was treated with calcium chloride before discharging to the Scott Road tile drain. Subsequent to the 1979/80 survey the site was capped and a leachate collection system installed. Leachate is now shipped off property for treatment and disposal.

The Dow Chemical disposal site is located directly north of Fiberglas. A reinforced steel barrier composed of interlocking steel pilings retains all leachate within the disposal site (pilings down to clay bed at 3-4 meters). The leachate is collected in a pond at the north edge of the property and pumped through carbon filters before being discharged to the Scott Road Ditch. This discharge is intermittent and depends on precipitation and the level of leachate in the pond. Leachate from the Dow disposal site, prior to the installation of the carbon filters contaminated the sediments of the Township Ditch, right down to the river, with Hexachlorobenzene (HCB) and Hexachlorobutadiene. In 1982 Dow dredged the affected section of the Ditch and disposed of the sediment at the company dump site.

The Polysar disposal site is located south and east of the Dow site. The leachate is aerated and then directed to a fly ash pond which acts as a filter/absorbant. Runoff and treated leachate from the fly ash pond discharges periodically to the Scott Road Ditch.

Holmes Insulation Limited is located on Scott Road and discharges cooling water only to the Scott Road Ditch opposite the Imperial Oil waste dump. Pipe insulation, insulating block, board, felts, blankets and cements, bulk and blowing wool are manufactured on site. Process water is entirely recycled.

Grab samples of the Holmes discharge to the Ditch were taken on August 29 and September 5, 1979. Grab samples from the Scott Road Ditch itself, upstream of the Fiberglas disposal site, were collected on the same dates. The Scott Road Ditch was also sampled at the point where it joins the Township Ditch on June 14, 27 and August 29 at 10:00 and 10:30 a.m. and September 5 at 17:00 and 17:30, 1979. Grab samples from the Fiberglas disposal area treated leachate discharge were collected on August 29 and September 5, 1979.

Upstream of the point at which it joins the Scott Road Ditch, the Township Ditch receives surface runoff from the areas of Plank and Indian Roads and the MacGregor Side Road, and cooling water from Dome Petroleum. At the junction of these two ditches, until 1980, tank farm runoff from the Imperial Oil storage area discharged to the Ditch. The storage area also has a disposal site for leaded gasoline bottoms. The tank farm discharge was sampled once on August 29, 1979. An additional sample of the Township Ditch, just downstream of this junction at the north-south CNR tracks was also collected August 29,

Moving further downstream, there are inputs to the Ditch from CNR (runoff), Esso Chemical (stormwater), Cabot Carbon, Fiberglas (factory) and Polysar (Styrene II only). Cabot Carbon manufactures carbon black from liquid feedstock and natural gas. Cooling tower blowdown, laboratory wastes, boiler blowdown, equipment wash water and surface runoff discharge to the Township Ditch. In 1979 this wastewater was untreated, however a

wastewater treatment system is now being installed to remove carbon black from the effluent. This will include a collection system, settling ponds and sand filtration.

Fiberglas manufactures glass fiber insulation with phenolic and urea resins incorporated into the product. Process water passes through a solids separator before combining with cooling water and discharging to the Ditch. The process water contains minute beaded glass and would not normally be contaminated by resins unless a spill occurred within the plant.

The Fiberglas and Cabot Carbon effluents were both sampled on August 30, 1979. The Polysar Styrene II unit discharges cooling water, tank farm runoff and other surface runoff to the Township ditch, after combining with the Fiberglas discharge. As of 1982, the Polysar Butyl II unit also discharged cooling water via this stream.

The final section of the Township Ditch is lined with concrete and flows through Polysar property. It receives mainly cooling water and stormwater runoff as well as vent steam recovery condensate and R and D laboratory wastewater. Cooling water from Monsanto, which manufactured ABS plastics, also discharged to this section of the ditch at the time of the survey. Monsanto process water is discharged to the Sarnia WPCP. The plant was permanently shut down in 1982; however, it has been bought and will re-open under a new name. The Township Ditch was sampled upstream of Polysar (Ditch In) and at its point of discharge at the river (Ditch Out) on June 12 (Out only), June 27 and August 2, 1979.

In 1980 a more intensive survey of the Ditch was conducted at these last two locations bordering Polysar.

B:2.0 Municipal Water Pollution Control Plants (WPCP's)

B:2.1 Village of Point Edward WPCP

The Point Edward WPCP is a primary treatment plant, employing phosphorus removal, with a design capacity of 2.59 x $10^3 m^3/d$. A grab sample of the chlorinated effluent was taken once on August 22, 1979. Operating data for the month of August 1979 indicated an 18% removal of BOD_5, 54% removal of suspended solids (SS) and a zero removal of phosphorus. However, on an annual average basis, this plant achieved 57% removal of BOD_5, 70% removal of SS and 72% removal of phosphorus. The annual average final effluent concentrations were 105 mg/L BOD_5, 95 mg/L SS and 6.6 mg/L total phosphorus (see Figure B:12).

B:2.2 City of Sarnia WPCP

The Sarnia WPCP employs primary treatment with phosphorus removal and has a design capacity of 65.9 x 10^3 m^3/d. Grab samples of the raw influent, prechlorinated effluent and chlorinated final effluent were collected on September 5, 1979. During September 1979 the plant removed 55% of the influent BOD_5 and 80% of the phosphorus (suspended solids were not analyzed). The average annual removals during 1979 were 57% BOD_5, 83% SS and 78% phosphorus. The annual average final effluent concentrations were 60 mg/L BOD, 30 mg/L SS and 1.4 mg/L phosphorus (see Figure B:13).

B:2.3 Moore Township (Corunna) WPCP

The Corunna WPCP is an extended aeration/contact stabilization treatment plant employing phosphorus removal. It has a design

capacity of 4.36 x $10^3 m^3/d$. A grab samples of the final chlorinated effluent was taken once in August 22, 1979. During the month of August, this plant achieved 96% removal of BOD_5, 64% removal of SS and 66% removal of total phosphorus. The 1979 annual average removals of BOD_5, SS and total phosphorus were 96% and 78% respectively. The annual average effluent concentrations were 3.6 mg/L BOD_5, 9.9 mg/L SS and 1.7 mg/L total phosphorus (see Figure B:14).

FIGURE B.12 VILLAGE OF POINT EDWARD WPCP (1979)

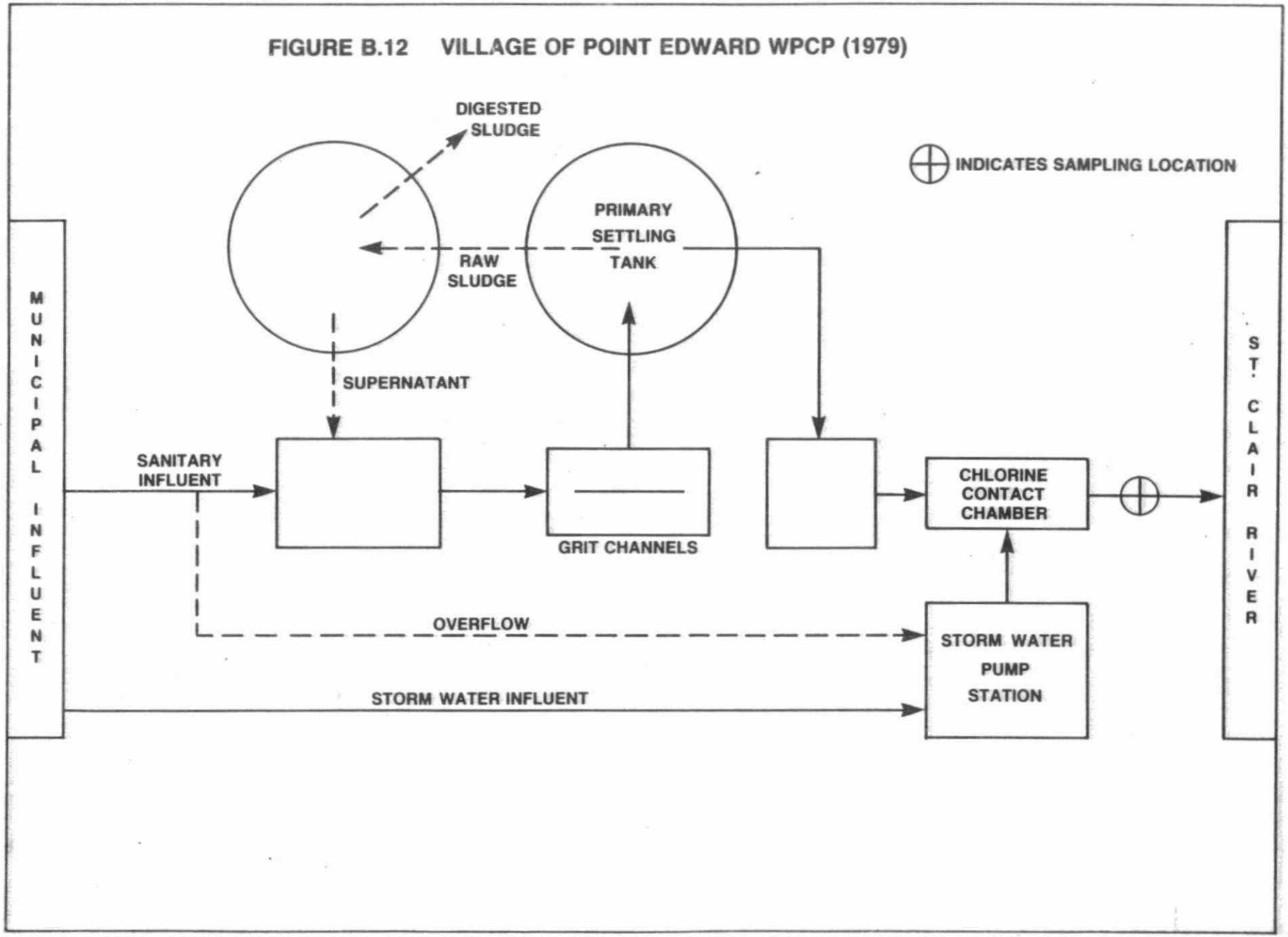


FIGURE B.13 CITY OF SARNIA WPCP (1979)

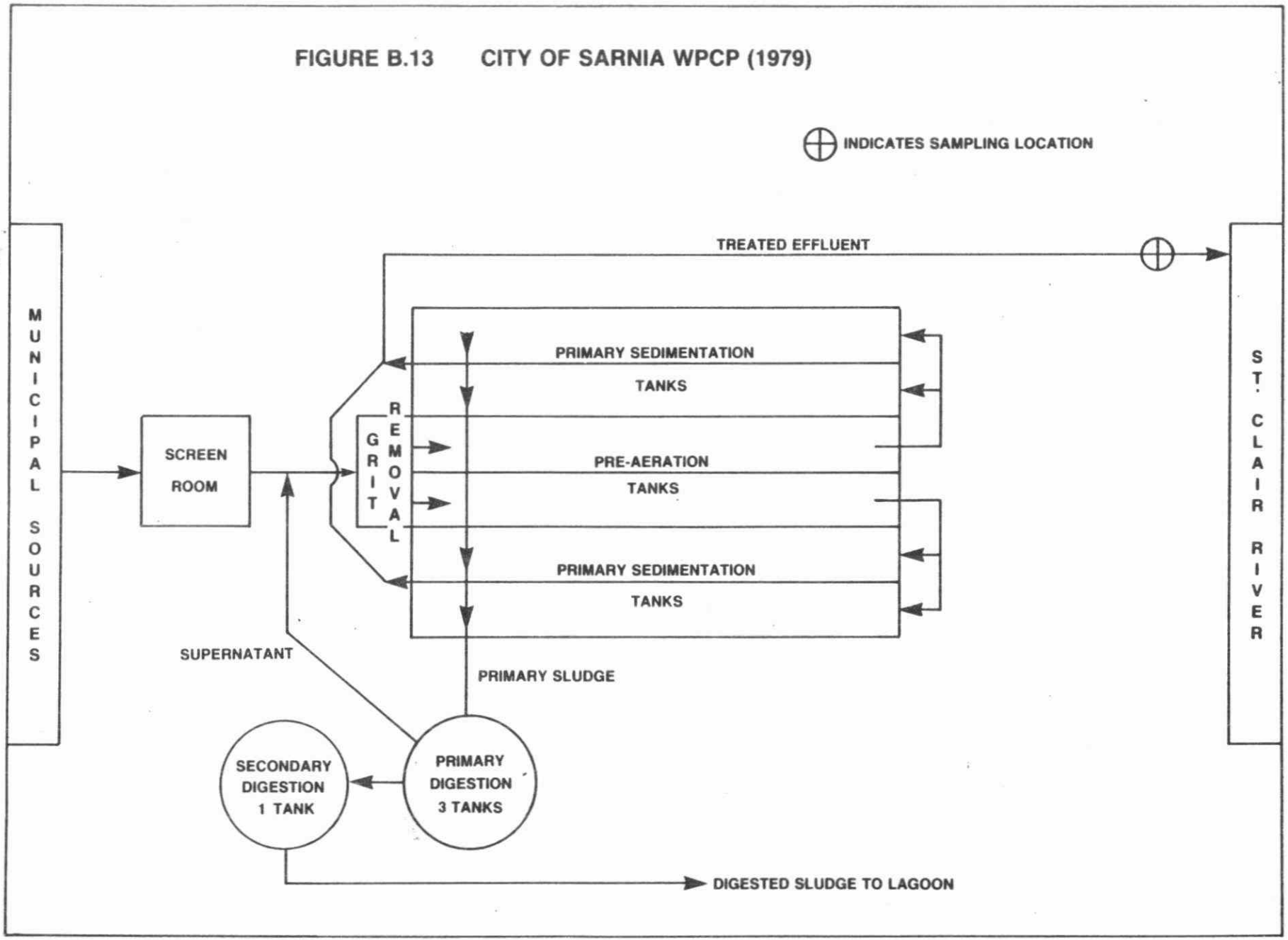
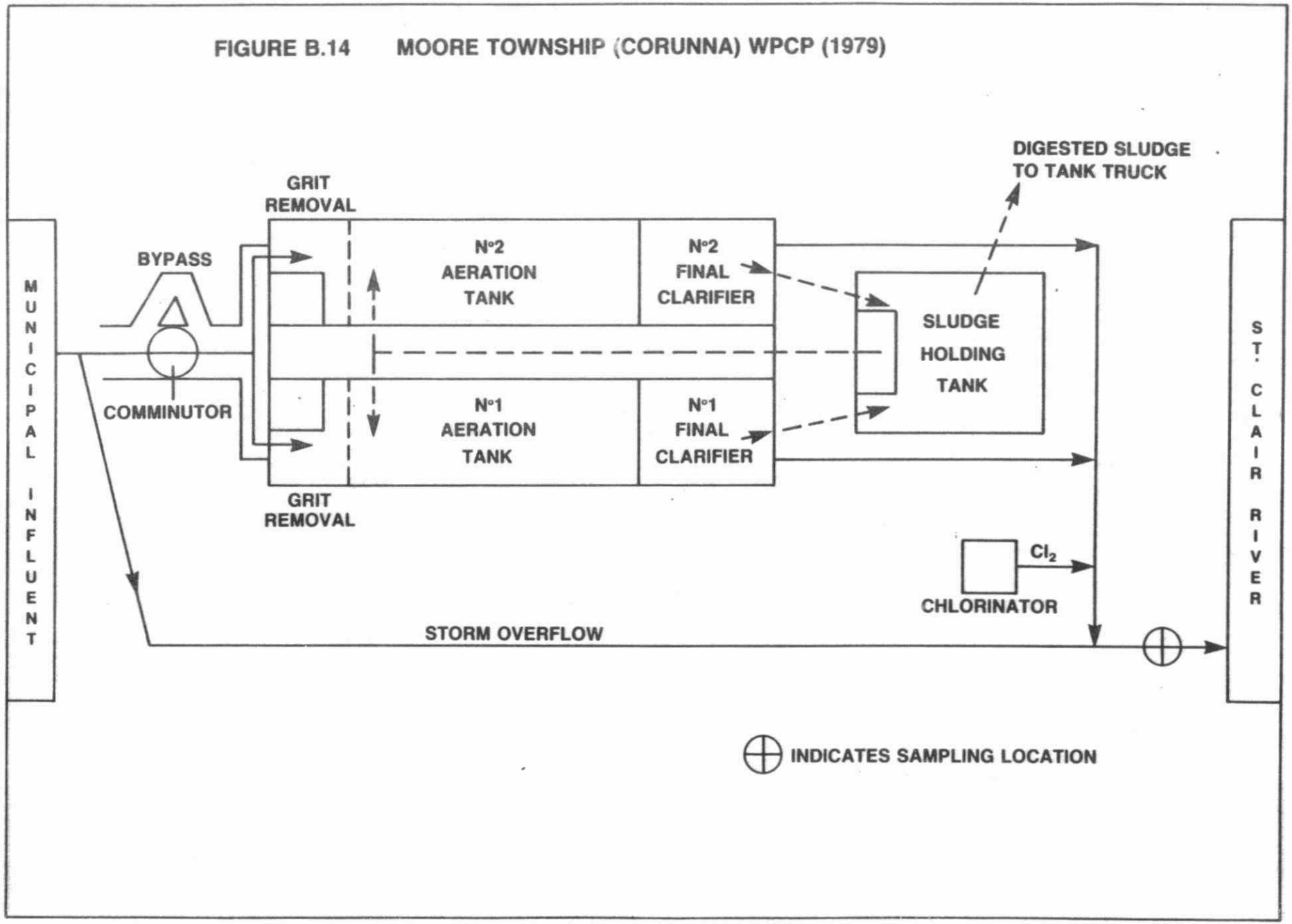


FIGURE B.14 MOORE TOWNSHIP (CORUNNA) WPCP (1979)



APPENDIX C

ORGANIC ANALYSIS TECHNIQUES

APPENDIX C

C:1.0 Analytical Protocols

The parameters to be analysed were a group of EPA priority pollutants including volatile organics and basic/neutral and acidic extractable organics. The list of compounds analysed is presented in Table C.1.

The analysis of environmental samples for the presence of trace organic contaminants poses a complex problem. The three main stages in the analytical train are a concentration step, followed by separation of the individual components and then their detection.

C:1.1 Concentration:

The concentration step is well standardized and usually involves a purging of the sample with inert gas and trapping the volatile organics and an extraction of the less volatile organics.

C:1.2 Separation:

The separation step for the compounds of interest here would normally be gas chromatography. This technique is capable of analyzing for the organics chosen if the appropriate conditions are used. As the complexity of the environmental sample increases, more organics need to be separated and the optimal route to take would be the use of high resolution capillary columns. At the time of this study, however, the US/EPA were advocating the use of packed columns in their analytical protocols. Their approach used columns which were selective for the compounds of interest and a different stationary phase was used for each fraction. The decision

Table C.1 Organic Compounds Analysed, Listed By Class

AROMATICS

- * Benzene
- * Toluene
- * Ethylbenzene

CHLORINATED ALIPHATICS

- * Methylene chloride
- Trichlorofluoromethane
- 1,1-Dichloroethylene
- 1,1-Dichloroethane
- Trans-1,2-dichloroethylene
- Chloroform
- 1,2-Dichloroethane
- 1,1,1-Trichloroethane
- * Carbontetrachloride
- Dichlorobromomethane
- Bis(2-chloromethyl)ether
- 1,2-Dichloropropane
- Trans-1,3-dichloropropylene
- * Trichloroethylene
- Chlorodibromomethane
- 1,1,2-Trichloroethane
- Cis-1,3-dichloropropene
- 2-Chloroethylvinylether
- Bromoform
- 1,1,2,2-Tetrachloroethane
- Tetrachloroethylene
- Hexachloroethane
- Hexachlorobutadiene

CHLORINATED AROMATICS

- Chlorobenzene
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene
- 1,2-Dichlorobenzene
- 1,2,4-Trichlorobenzene
- 2-Chloronaphthalene
- * Hexachlorobenzene

OTHER CHLORINATED COMPOUNDS

- Bis(2-chloroisopropyl)ether
- Bis(2-chloroethoxy)methane
- 4-Chlorophenyl phenyl ether
- 4-Bromophenyl phenyl ether
- 3,3'-Dichlorobenzidine

NITRO COMPOUNDS

- Nitrobenzene
- 2,6-Dinitrotoluene
- 2,4-Dinitrotoluene

NITROSO COMPOUNDS

- N-Nitroso-di-n-propylamine
- N-Nitrosodiphenylamine

PHTHALATES

- Dimethyl phthalate
- Diethyl phthalate
- Di-n-butyl phthalate
- Butyl benzyl phthalate
- Bis(2-ethylhexyl)phthalate
- * Di-n-octyl phthalate

FUSED RING COMPOUNDS

- Naphthalene
- Acenaphthylene
- Acenaphthene

Fluorene
Phenanthrene
Anthracene
Fluoranthene
Pyrene
Chrysene
Benz(a)anthracene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Indeno(1,2,3-c,d)pyrene
Dibenzo(a,h)anthracene
Benzo(g,h,i)perylene

MISCELLANEOUS

1,2-Diphenylhydrazine
Benzidine

PHENOLS

Phenol
2-Chlorophenol
2,4-Dimethylphenol
2-Nitrophenol
2,4-Dichlorophenol
2,4,6-Trichlorophenol
2,4-Dinitrophenol
4-Nitrophenol
Pentachlorophenol

CRESOLS

p-Chloro-m-cresol
4,6-Dinitro-o-cresol

was therefore made during the study planning stage to implement a packed column GC approach. The major reasons were: consistency with EPA's analytical approach; the relative unfamiliarity with capillary gas chromatography at the time of initiation of the study and the extent of development work necessary in order to incorporate this new technology into the project.

C:1.3 Detection

The detection of organics eluting from a gas chromatograph can be carried out in several different ways. The flame ionization detector (FID) is a universal detector which responds well to most organic compounds regardless of structure. This has the advantage in that all compounds of interest can be analysed in one detection system but has the disadvantage that other compounds which are irrelevant to the present study will also be detected and may cause interference. The electron capture detector (ECD) is one which introduces selectivity into the detection of organic compounds since it responds only to compounds containing electron capturing groups. Examples of these groups are the halogens - chlorine, bromine, fluorine and nitro groups. The ECD ignores organics such as aliphatic hydrocarbons which can cause severe interference in an FID analysis. These two are the most generally applicable detectors in environmental analysis.

C:1.4 Gas Chromatography/Mass Spectrometry

The other major detection system to be considered is mass spectrometry. The FID and ECD detectors are used in conjunction with the retention time of a compound on the GC column to establish its identity. No information is available from this approach regarding the structural features of that compound. There is a possibility, which increases with the

increasing complexity of the sample matrix, that the compound responding is an interference rather than the target compound. If the GC effluent is subjected to mass spectrometry, additional information is available on the organics eluting at particular retention times. This information often includes the molecular weight of the compound as well as indications of the functional groups present and the structure of the total molecule. The mass spectrum of the compound, which contains characteristic fragmentations can be searched against computer-based libraries of many thousands of compounds in order to determine or confirm the identification of a particular component. Gas chromatography combined with mass spectrometry (GC/MS) is therefore an extremely powerful tool in the analysis of complex environmental samples. It is, however, a technique which requires considerable expertise in its use and in the interpretation of the data and is a costly approach to implement.

It was impractical to undertake a study of this magnitude using a GC/MS approach. The analytical approach chosen for the analysis of samples in this study was that of packed column gas chromatography after a suitable sample concentration step. The detection of the organics present was to be detection of the organics present was to be carried out with an FID and in conjunction with an ECD, where appropriate. The confirmation of approximately 5% of samples by GC/MS was originally planned for quality assurance purposes. Owing to the complexity of the samples, additional GC/MS confirmation was found to be required in order to improve data quality.

C:1.5 Volatiles:

The analysis of volatile organics was carried out by a modified Bellar and Lichtenberg procedure as recommended by EPA. The sample is purged with an inert gas onto a Tenax trap, thermally desorbed and the components separated by packed column gas chromatography with detection by combined FID and ECD. The use of combined detectors increases the specificity

of the analysis. Quantification (estimated) was achieved by using an internal standard added to each sample prior to purging. Detailed methodology is found on page .

C:1.6 Extractables

The analysis of extractable organics utilized a modified EPA extraction protocol as generally used in the Organic Trace Contaminants Section of the Ministry of the Environment. The extraction was carried out with methylene chloride at pH 11 and pH 2 for the separation of basic/neutral and acidic extractables respectively. The extracts were then analysed by packed column gas chromatography using FID. The acid extracts were also subjected to an ECD in order to increase the specificity of the analysis for chlorinated and nitro-compounds. Quantification (estimated) was achieved using an internal standard added to each sample prior to extraction. Detailed methodology is found on page .

C:1.7 Supplementary Clean-Up Techniques:

Some of the extracts investigated were extremely complex in that they included a "hydrocarbon envelope" which interfered with many of the analytes. A "hydrocarbon envelope" is formed when many aliphatic and/or alicyclic hydrocarbons are present in a sample. The number of structural isomers of a hydrocarbon with ten or more carbon atoms in the chain becomes very large and the individual compounds cannot be resolved on the GC column. Instead of producing discrete peaks, these compounds form a hump on the baseline and this is known as an envelope. If compounds other than the hydrocarbons elute in this same region they may be "lost" in the group of unresolved organics and never identified. These hydrocarbons can be removed by using a florisil column and carrying out selective elution steps. The details of this technique are found on page .

C:1.8 Quality Control

The initial study design incorporated quality control (QC) samples to be analysed by GC/MS at Environment Canada, Inland Waters Directorate (IWD), Burlington. The total extent of these confirmational analyses was to be approximately 5% of sample extracts. Some additional QC was planned for the volatile samples at MOE.

Additional analyses were carried out for quality assurance purposes by two other laboratories using capillary gas chromatography/mass spectrometry techniques (GC/MS). These laboratories were MOE (Organic Trace Contaminants Section), Environment Canada - Air Pollution Control Directorate (APCD), Ottawa. Volatiles were confirmed only at MOE using a separate sample aliquot and employing packed column GC/MS. Extractable organics were analysed by all three laboratories with aliquots of the extract used for GC analysis being submitted for capillary GC/MS confirmation.

The optimal use of available GC/MS resources had to be considered. The volatile organics were routinely analysed by a combined FID/ ECD detection system in this study. This combination provided additional confirmatory evidence for the presence of halogenated organics because of the increased specificity of the ECD for these compounds, reducing the need for GC/MS confirmation.

The acid extractable organics were also confirmed by reanalysing the sample using an ECD to give additional specificity for halogenated or other electron-capturing groups. The phenolics analysed included nine compounds which gave good response on the ECD, only two compounds of the group gave no response, therefore reducing the need for GC/MS confirmation for these samples. The final group of organics, the base/-neutral organics contained proportionately fewer organics which would give good responses on an ECD and so using this

technique to achieve additional specificity in this analysis was not possible. Therefore the major emphasis on the use of GC/MS resources for quality control was placed on the confirmation of organics in the base/neutral fractions of each sample.

The choice of fractions to be analysed by GC/MS was governed by the large number of samples requiring confirmational analysis. The choice was made on the following basis:

1. The site was sampled more than once.

2. The sample was the most complex of the group taken from one industry, as determined by the GC analysis.

3. Where resources permitted, a pre-treated sample and a final effluent were analysed.

Industries or locations (such as Point Edward and Corunna STP) which were sampled only once were not analysed by GC/MS. Intake waters, which tended to be much cleaner than effluents were not analysed by GC/MS for most industries. Samples which were extremely complex, such as the township ditch-out and Dow sewers were analysed by GC/MS on more than one occasion. All base/neutral fractions of Polysar Chem. DAF and Oily DAF were analysed by GC/MS in 1980.

C:1.9 Data Interpretation:

Potential interferences encountered when analysing complex samples by packed columns resulted in a decision to present the data on a semi-quantitative basis rather than in the quantitative manner initially planned for the study.

The following are the guidelines used in the semiquantitative interpretation of the data.

(a) Volatiles

Identification of components was based on responses on both the FID and ECD detectors (where appropriate). The more specific ECD detector gives increased confidence of the presence of a halogenated compound.

1. Where the values are in the same category (i.e. A, B, C, etc.) from both FID and ECD then that category is quoted.

2. If the values are in different categories then the lowest category is quoted-this is done because the higher value is likely to be from an interference. In most of the cases the more specific detector, the ECD, gave the lowest values.

3. Benzene coelutes with cis-1,3-dichloropropene and 2-chloroethylvinyl ether. Where a higher value is obtained for the FID it is assumed to be caused by a high benzene concentration and this value is used.

4. In many samples with high (high ppb or ppm) concentrations of benzene, a shift in retention time was noted. Quality Assurance using MS data was used to assign correctly the identification of the benzene peak and recalculation was carried out if the data system had not made the correct assignment.

5. If the MS quantification placed the result in a different but lower category than the GC quantification then the MS quantification was used in order to compensate for the possibility of an interference in the GC analysis.

6. If the presence of a compound detected by GC is not confirmed by GC/MS - then an asterisk is placed in the tabulated data opposite that compound.

7. The GC/MS identification of peaks is taken as the authoritative source and is extrapolated to associated discharges taken at the same or different times. These extrapolations are indicated as dashes.

(b) Extractables

Identification of a component was based on retention times and on the response on an FID in the GC analysis. Specific detection by ECD for nitro and halogenated phenolics required the presence of a response on both FID and ECD for an identification to be confirmed.

1. Wherever possible one of the base/neutral extracts from each effluent was analysed by GC/MS for confirmation of identification of components. The extract chosen for GC/MS was the one with the largest number of apparent components in the GC-only analysis.

2. The technique providing the lowest quantitative result for the confirmed compound was used when different results were obtained by GC and GC/MS. This approach was taken to compensate for interferences occurring in the GC analysis.

3. The results from the GC/MS QA analysis were then applied to the effluents taken from the same location and associated discharges but at differing times.

When choosing the extracts for GC/MS confirmation, the choice was based on the complexity of the extract. It was not always possible to confirm the analysis of frac-

tions of all the individual discharges so many of these remain unconfirmed.

GC responses corresponding to trichlorofluoromethane and 3,3¹ - dichlorobenzidine were seen in many samples but their presence was not confirmed by GC/MS. Based on the GC/MS data, these responses are attributed to interfering compounds.

C:2.0 Extraction Techniques

C:2.1 Liquid/Liquid Extraction

This method is rapid and has acceptable recovery for many organic compounds of interest in the environment including 80 of the compounds defined as unambiguous priority pollutants by EPA.

C:2.2 Apparatus

Separatory funnels - 1 litre with teflon stopcock
Flask for rotary evaporation
Graduated conical centrifuge tubes

C:2.3 Procedure

Bring samples to room temperature prior to extraction (at least 1 hour). Wash thoroughly all glassware to be used in the extraction procedure with the solvent to be used. Transfer 800 ml of sample into the separatory funnel.

C:2.4 Base/Neutral Extraction

Add 2,4-dinitroanisole as internal standard (10 µl equivalent to approximately 20 µg) to each sample and blank. Adjust the pH of the sample to 11 or greater using 6N NaOH. Use multi-range pH paper for the measurement. Serially extract with 80 x 30 x 30 ml portions of distilled-in-glass methylene chloride. Each extraction funnel must be shaken vigorously for at least 2 minutes. The phases are allowed to settle for a minimum of 3 minutes or until the two phases are distinct. The solvent is

then filtered through pre-washed glass wool and pre-extracted granular sodium sulphate into a 250 ml round-bottomed flask.

The combined extracts in the flask are then rotary evaporated to near dryness using a water aspirator to create a vacuum and a water bath at room temperature. The concentrated extract is then transferred to a calibrated 15ml centrifuge tube. The sample is rinsed into the tube with the same solvent using 2 ml, 1 ml and 1 ml aliquots. The same pipette used for transferring the liquid is then used for the final evaporation step so that cross-contamination is avoided. The tube is placed in a water bath at 30°C with a flow of dry nitrogen which is barely perceptible, in order to reduce the incidence of aerosols. The pipette is lowered as the solvent evaporates. Evaporation is continued until the appropriate volume of solvent remains (approximately 1 ml.) The solution is then transferred by a pasteur pipette to a 2 ml vial with small quantities of methylene chloride. The vial is then capped with a teflon-lined cap and stored in the refrigerator until the analysis is performed. If necessary the sample is evaporated down to approximately 0.1 ml.

C:2.5 Acid Extraction

Add 2-nitro-naphthalene as internal standard (10 µl equivalent to approximately 10 µg) to each sample and blank. Adjust the pH of the base-neutral extracted water with 1:1 v/v H_2SO_4 to 2 or less. Serially extract with 40, 20, 20 ml portions of distilled in glass methylene chloride. Proceed as described for the base-neutral extract.

C:2.6 Blanks

A parallel extraction of 800 ml millipore-water should be carried out with each set of samples analyzed to act as a

blank. The amount of solvent used in each step should be identical to that used for the samples.

C:2.7 NOTES

Emulsions

Various techniques can be used in order to break emulsions. These include:

1) Addition of pre-extracted sodium chloride crystals.
2) Addition of further aliquots of solvent.
3) Draw off the small amount of free solvent that separates and slowly drip it back in the top of the separatory funnel through the sample and emulsion.

Other possibilities if these fail: centrifugation, passing emulsion through methylene chloride - wet glass wool, allowing to stand for up to 24 hours, stirring with a glass rod, heating on a steam bath or with a heat gun, sonication.

Any of these techniques used, which involve any additions to the sample should also be applied to the blank.

Evaporation

Rotary evaporation cautions:

1) If the water bath temperature is too high, bumping can occur and this can cause loss of sample.

2) Never allow flask to go to dryness.

C:2.8 Base-Neutral Extractables - GC Analysis

Once the sample is extracted the analysis is carried out with conditions described below:

Gas Chromatographic Conditions

Varian 3700 GC
Column: 6' x 1/8" i.d. 3% SP2250 DB on 100/120 Supelcoport
Detector Temperature: 330°C
Injector Temperature: 220°C

Oven Temperature: 1) 50° hold 4 min
2) Program at 8°/min to 270°
3) Hold at 270° for 10 min

Carrier Gas: Ultra High Purity Nitrogen
Flow: 30 ml/min

FID: Hydrogen: 30 ml/min
Air: 300 ml/min

GC is also equipped with ECD

C:2.9 Acid Extractables - GC Analysis

These are analyzed with the conditions described below:

Gas Chromatographic Conditions
Varian 3700 GC

Column: 6' x 1/8" i.d. Tenax GC 60/80 mesh

Detector temperature: 330°C

Injector temperature: 220°C

Oven Temperature: 1) Initial temperature 180°
2) Program at 8°/min to 300°
3) Hold at 300° 5 min

Carrier Gas: Ultra High Purity Nitrogen
Flow: 30 ml/min

FID: Hydrogen: 30 ml/min
Air: 300 ml/min

^{63}Ni ECD - Makeup gas U.H.P. Nitrogen

The GC is equipped with a Varian autosampler for overnight analyses. A standard solution is placed after every five samples in order to monitor any changes occurring in the conditions.

The GC is also attached to an SP4000 data system and quantification is based on the relative area response of an individual component or a group of components compared to the internal standard for each analysis.

Calibrations are carried out daily and the calibration factor (KF) for each component of interest is determined with an external standard containing all the components of interest and also contains the internal standard.

$$K_F = \frac{\frac{\text{Area (X)}}{\text{Amount (X)}}}{\frac{\text{Area (S)}}{\text{Amount (S)}}}$$

Where: Area(X) = peak area of the compound
Amount(X) = quantity of the compound injected
Area(S) = peak area of the internal standard
Amount(S) = quantity of the internal standard injected

The final concentration of the unknown in µg/l is computed with the following equation when the internal standard is employed.

$$C(X) = \frac{Area(X) \times Amount(S)}{KF \times V \times Area(S)}$$

Where: C(X) = Concentration of the unknown in the original sample in micrograms per litre.

Amount(S) = The quantity of internal standard added to the sample in µg.

V = The volume of the original sample in litres

The retention time window used for all components is ± 3%.

Clean-ups

When the "hydrocarbon envelope" is found to be excessive the samples are submitted to a cleanup procedure using Florisil.

C:3.0 Purge and Trap Analysis on Tekmar LSC 11

C:3.1 General

This procedure is used for the analysis of volatile components in a sample. All samples must be stored in a bottle with no headspace and with an aluminum foil cap. The samples should be stored in the refrigerator and analysed as soon as possible.

C:3.2 Apparatus

Tekmar LSC II equipped with 12" x 1/8" o.d. tenax trap and 5 ml sampler, 20 ml vial with teflon lined cap.

C:3.3 Procedure

10 ml of sample is transferred to a pre-cleaned 20 ml vial and 2 µl internal standard solution (Bromobenzene 200 ng/µl) is added. The sample is mixed by inversion. 5 ml of the sample is added to the sampler with a syringe. The sample is purged for 15 minutes at room temperature with 38 ml/min flow of high purity nitrogen onto the tenax trap. The trap is desorbed at 180°C for 4 minutes onto the GC column. During the desorption the column is held at 30°C and programming starts once the desorption is complete and baking of the trap for cleaning purposes is initiated. The GC column effluent is split into an ECD and FID.

C:3.4 GC Conditions

Varian 3700 GC
Column: 6' x 1/8" i.d. 0.2% Carbowax 1500 on 60/80 mesh Carbopack C.
Detector Temperature: 330°C
Injector Temperature: 220°C

Oven Temperature: 1. 30° for 4 min.
2. Program at 6°/min to 170°
3. Hold at 170° for 10 min.

Carrier Gas: Ultra High Purity Nitrogen
Flow: 30 ml/min

Splitter: Glass; nominally 10:1
FID exit flow: 28 ml/min
ECD exit flow: 7 ml/min (with make-up gas)

C:3.5 Quantification

Quantification is based on the relative responses of individual compounds compared to the internal standard.

Calibrations are carried out daily and the calibration factor (KF) for each component of interest is determined with an external standard containing all the components of interest and also contains the internal standard.

$$K_F \quad \frac{\frac{\text{Area(X)}}{\text{Amount (X)}}}{\frac{\text{Area(S)}}{\text{Amount(S)}}}$$

Where:
Area(X) = peak area of the compound
Amount(X) = quantity of the compound injected
Area(S) = peak area of the internal standard
Amount(S) = quantity of the internal standard injected

The final concentration of the unknown in µg/l is computed with the following equation when the internal standard is employed.

$$C(X) = \frac{\text{Area}(X) \times \text{Amount}(S)}{KF \times V \times \text{Area}(S)}$$

Where: C(X) = Concentration of the unknown in the original sample in micrograms per litre.

Amount(S) = The quantity of internal standard added to the sample in µg.

V = The volume of the original sample in litres.

The retention time window used for all components is $\pm$ 3%.

APPENDIX D

1979 ORGANIC DATA

Compound	Service Water			Raw			Final (Comp.)			Drainage
	054	072	0101[2]	055[2]	073[3]	0102[2]	059	074 (grab)	0103	0126[1]
Methylene chloride										
Trichlorofluoromethane										
1,1-Dichloroethylene										*
1,1-Dichloroethane										A
Trans-1,2-dichloroethylene				B	B	A	B	B		*
Chloroform	B		A	B		A			A	A
1,2-Dichloroethane				A		A				A
1,1,1-Trichloroethane				A						
Carbontetrachloride[5]										
Dichlorobromomethane + Bis(2-chloromethyl)ether				A						
1,2-Dichloropropane				A		B				A
Trans-1,3-dichloropropylene				A		B				
Trichloroethylene + Chlorodibromomethane + 1,1,2-Trichloroethane				A	A	B	A			A
Cis-1,3-dichloropropene + Benzene + 2-Chloroethylvinylether				D	D	D				B
Bromoform				A		A				*
1,1,2,2-Tetrachloroethane + Tetrachloroethylene				A	A	C				B
Toluene				C	C	B				*
Chlorobenzene				B	B	A				*
Ethylbenzene				C	B					
1,3-Dichlorobenzene				*	-	*				
1,4-Dichlorobenzene										
Hexachloroethane										
1,2-Dichlorobenzene										
Bis(2-chloroisopropyl)ether				*	-					
Nitrobenzene				*	-					
N-Nitroso-di-n-propylamine					-			-		
Bis(2-chloroethoxy)methane										
Hexachlorobutadiene				*	-	*		-		-
1,2,4-Trichlorobenzene				*	-	*				
Naphthalene				B	C	B		A		
2-Chloronaphthalene				*	-	*		-		-
Acenaphthylene				B	B	C		A		A
Acenaphthene				B	B	C		A		
Dimethyl phthalate				*	-	*	-		-	-
2,6-Dinitrotoluene				*	-			-		-
Fluorene + 4-Chlorophenyl phenyl ether				B	B	C		B		
Diethyl phthalate + 2,4-Dinitrotoluene				*	-	*		-		-
1,2-Diphenylhydrazine					-			-		
N-Nitrosodiphenylamine + Hexachlorobenzene + 4-Bromophenyl phenyl ether				B	B	A		B		A
Phenanthrene + Anthracene				B	B	C	A	A		A
Di-n-butyl phthalate				*	-	*	-	-		-
Fluoranthene				C	C	B		A		
Pyrene				B	B	C		A		
Benzidine		-			-			-		-
Butyl benzyl phthalate					-	*	-			-
Bis(2-ethylhexyl)phthalate	-	-	*	*	-		-	-	-	-
Chrysene					A	B				
Benz(a)anthracene				A	A	B				
3,3-Dichlorobenzidine					-		-	-		-
Di-n-octyl phthalate			*		-	*			-	-
Benzo(b)fluoranthene + Benzo(k)fluoranthene						*				-
Benzo(a)pyrene							-			-
Indeno(1,2,3-c,d)pyrene + Dibenzo(a,h)anthracene										
Benzo(g,h,i)perylene										-
Phenol				D		C				
2-Chlorophenol										
2,4-Dimethylphenol + 2-Nitrophenol						A			A	
2,4-Dichlorophenol										
p-Chloro-m-cresol										
2,4,6-Trichlorophenol										
2,4-Dinitrophenol	A									
4-Nitrophenol					A			A		
4,6-Dinitro-o-cresol					B			A		
Pentachlorophenol										

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
3. acid fraction analyzed by GC/MS
4. concentration ranges:
   - A = 1 - 10 ug/L
   - B = 10 - 100 ug/L
   - C = 100 - 1000 ug/L (1000 ug/L = 1 mg/L)
   - D = 1 - 10 mg/L
   - E = 10 - 100 mg/L
   - F = 100 - 1000 mg/L
   - * = peak identified by GC but not confirmed by GC/MS analysis
   - - = peak identified by GC but not confirmed by GC/MS analysis of samples from related sites
5. + = compounds not separated by GC methodology

Compound	Raw			Dual Media Filter			A/C Filter				Final			
	2 O75	2 O106	1,2 O153	O76	O107	O154	O57	O77	O108	O155	O58	O78	O109	O156
Methylene chloride	B	B	B		B	B					B		B	B
Trichlorofluoromethane			*											
1,1-Dichloroethylene			*											
1,1-Dichloroethane														
Trans-1,2-dichloroethylene			*				-	-	-	-				
Chloroform	-	-		-		-	-	-		-	-		-	
1,2-Dichloroethane	-	-	*	-	-	-		-	-		-		-	-
1,1,1-Trichloroethane		-	*		-	-			-					
Carbontetrachloride														
Dichlorobromomethane + Bis(2-chloromethyl)ether														
1,2-Dichloropropane														
Trans-1,3-dichloropropylene					-								-	-
Trichloroethylene + Chlorodibromomethane + 1,1,2-Trichloroethane	-	-	*		-	-			-		-			-
Cis-1,3-dichloropropene + Benzene + 2-Chloroethylvinylether	B	E	E	D	E	B	D	E	F	E	B		C	A
Bromoform	-	-	*	-	-	-		-	-	-	-			-
1,1,2,2-Tetrachloroethane + Tetrachloroethylene	A	A	B	A	A	A	A	A	A		A			
Toluene	B	E	D	C	E	B	C	C	E	D	A		B	
Chlorobenzene			B*					A	C	A				
Ethylbenzene			C				A		C	B				
1,3-Dichlorobenzene	*		*		-	-	-	-	-	-	-	-	-	-
1,4-Dichlorobenzene														
Hexachloroethane			A					-					-	
1,2-Dichlorobenzene														
Bis(2-chloroisopropyl)ether					-									
Nitrobenzene					-			-	-					
N-Nitroso-di-n-propylamine							-	-						
Bis(2-chloroethoxy)methane	*													
Hexachlorobutadiene	*		*	-	-	-		-	-	-	-	-	-	-
1,2,4-Trichlorobenzene			*		-		-		-					
Naphthalene	B		A	C	C	B		B	B	B	B	B	B	A
2-Chloronaphthalene	*	*	*	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	A	A	B	D	C	C	-	A	C	A	-	C	C	A
Acenaphthene	C	A	C	D	C	B	A	A	C	B	C	C	B	A
Dimethyl phthalate	*	*	A	-	-	C	-	-	C	B	-	-	C	B
2,6-Dinitrotoluene	*	*		-	-		-	-	-					
Fluorene + 4-Chlorophenyl phenyl ether	B	A	B	C	C	B		B	C	B	C	C	C	A
Diethyl phthalate + 2,4-Dinitrotoluene	*	*	*	-	-	-	-	-		-	-	-	-	-
	*	*						-	-					
1,2-Diphenylhydrazine	*	*			-		-	-	-					
N-Nitrosodiphenylamine + Hexachlorobenzene + 4-Bromophenyl phenyl ether		*	*	C	-	-	-	-	-	-	-	-	-	-
Phenanthrene + Anthracene	B	B	A	C	C	B	A	A	C	B	B	B	B	A
Di-n-butyl phthalate	*	B	A	-	-	B		-	B		B	-	B	A
Fluoranthene	*	A	A	-	-	A		-	B		A	-	A	
Pyrene			A		B	A		A	A		A	A	A	
Benzidine					-			-	-			-		
Butyl benzyl phthalate	*	*			-	-								-
Bis(2-ethylhexyl)phthalate	A	A	B	B	-	A	A				A	A	A	A
Chrysene		A												
Benz(a)anthracene	*	A	A							B		-		
3,3-Dichlorobenzidine				-				-						
Di-n-octyl phthalate										-		-		-
Benzo(b)fluoranthene + Benzo(k)fluoranthene												-		
Benzo(a)pyrene														
Indeno(1,2,3-c,d)pyrene + Dibenzo(a,h)anthracene									-					
Benzo(g,h,i)perylene														
Phenol		A	B	A	A	B			B	A			A	A
2-Chlorophenol			A											
2,4-Dimethylphenol + 2-Nitrophenol	A	A	B	B	A	B			A	B		A		A
2,4-Dichlorophenol									A					
p-Chloro-m-cresol														
2,4,6-Trichlorophenol	A	A	B	B	A	A	A		B	B				
2,4-Dinitrophenol		A	D		A	C			C	C	B	B	B	B
4-Nitrophenol	A			B			A				A		-	
4,6-Dinitro-o-cresol			A				A							
Pentachlorophenol	B	B	B	C	B	B			C		B		B	

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
3. acid fraction analyzed by GC/MS
4. concentration ranges:
   - A = 1 - 10 ug/L
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   - D = 1 - 10 mg/L
   - E = 10 - 100 mg/L
   - F = 100 - 1000 mg/L
   - * = peak identified by GC but not confirmed by GC/MS analysis
   - - = peak identified by GC but not confirmed by GC/MS analysis of samples from related sites
5. + = compounds not separated by GC methodology

Compound	Service Water			Ditch In		Ditch Out			Styrene II	
	01	029[2]	079	034[2]	084[2]	07[2]	035[2]	085	093[2]	0116
Methylene chloride										
Trichlorofluoromethane										
1,1-Dichloroethylene										
1,1-Dichloroethane										
Trans-1,2-dichloroethylene				A	A				B	
Chloroform		A	A			A		A	A	A
1,2-Dichloroethane	A	A	A		A					
1,1,1-Trichloroethane										
Carbontetrachloride					A					
Dichlorobromomethane + Bis(2-chloromethyl)ether		A								
1,2-Dichloropropane					A					
Trans-1,3-dichloropropylene										A
Trichloroethylene + Chlorodibromomethane				A	A					A
1,1,2-Trichloroethane										
Cis-1,3-dichloropropene + Benzene + 2-Chloroethylvinylether				A	B			A		E
Bromoform			A	A	B	A		B		
1,1,2,2-Tetrachloroethane + Tetrachloroethylene				A	A			A		
Toluene				A			A			A
Chlorobenzene			A		A		A	B	A	
Ethylbenzene										B
1,3-Dichlorobenzene						*				
1,4-Dichlorobenzene										-
Hexachloroethane					A					-
1,2-Dichlorobenzene										-
Bis(2-chloroisopropyl)ether					A					
Nitrobenzene					A					
N-Nitroso-di-n-propylamine				-						
Bis(2-chloroethoxy)methane										
Hexachlorobutadiene				A						
1,2,4-Trichlorobenzene					A			-		-
Naphthalene									A	A
2-Chloronaphthalene						*		-		-
Acenaphthylene										A
Acenaphthene										A
Dimethyl phthalate	-	*		A		A	B			-
2,6-Dinitrotoluene						*		-		-
Fluorene + 4-Chlorophenyl phenyl ether									A	A
Diethyl phthalate + 2,4-Dinitrotoluene					A			-	A	A
1,2-Diphenylhydrazine	-					*		-	C	B
N-Nitrosodiphenylamine + Hexachlorobenzene + 4-Bromophenyl phenyl ether	-	*			A	A	B	B	A	-
Phenanthrene + Anthracene	-				A		A	A	A	B
Di-n-butyl phthalate			B					A		A
Fluoranthene								A		A
Pyrene		*			A					A
Benzidine					*			-		-
Butyl benzyl phthalate						*		-		-
Bis(2-ethylhexyl)phthalate	A	C			A	B	B	A	C	A
Chrysene										
Benz(a)anthracene	-	*				A	A			
3,3-Dichlorobenzidine	-				*	*		-		
Di-n-octyl phthalate		*							A	
Benzo(b)fluoranthene + Benzo(k)fluoranthene		*				*				
Benzo(a)pyrene		*								
Indeno(1,2,3-c,d)pyrene + Dibenzo(a,h)anthracene		*				*		-		
Benzo(g,h,i)perylene						*				
Phenol										
2-Chlorophenol										
2,4-Dimethylphenol + 2-Nitrophenol										
2,4-Dichlorophenol										
p-Chloro-m-cresol										
2,4,6-Trichlorophenol										
2,4-Dinitrophenol										
4-Nitrophenol					A					
4,6-Dinitro-o-cresol	A								A	A
Pentachlorophenol										A

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
3. acid fraction analyzed by GC/MS
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   - A = 1 - 10 ug/L
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   - F = 100 - 1000 mg/L
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5. + = compounds not separated by GC methodology

Compound	54" Sewer			66" Sewer			Stereo API				72" Sewer		
	04	032 [2]	083	03	031	081 [2]	02	030 [2]	080 [1,2]	094	05	033 [2]	08
Methylene chloride									B	B			
Trichlorofluoromethane													
1,1-Dichloroethylene						A			*				
1,1-Dichloroethane			A					-					
Trans-1,2-dichloroethylene	B			B	B								B
Chloroform							-	-	*	-	A	A	
1,2-Dichloroethane			A	B					*				
1,1,1-Trichloroethane													
Carbontetrachloride													
Dichlorobromomethane													
Bis(2-chloromethyl)ether													
1,2-Dichloropropane										-			
Trans-1,3-dichloropropylene	A				A		-	-	*	-			
Trichloroethylene													
Chlorodibromomethane							-	-					
1,1,2-Trichloroethane													
Cis-1,3-dichloropropene													
Benzene							A	A	B	E			
2-Chloroethylvinylether													
Bromoform				A						-			
1,1,2,2-Tetrachloroethane			A				-	-	*	-			
Tetrachloroethylene			A										
Toluene	A		A				B	A	A	A			
Chlorobenzene	A	A	B		A		-		*	-			
Ethylbenzene	B	A	B	A	A		-						
1,3-Dichlorobenzene			-										
1,4-Dichlorobenzene	-		-										
Hexachloroethane													
1,2-Dichlorobenzene													
Bis(2-chloroisopropyl)ether						*							
Nitrobenzene									*				
N-Nitroso-di-n-propylamine													
Bis(2-chloroethoxy)methane													
Hexachlorobutadiene			A		-								
1,2,4-Trichlorobenzene			-										
Naphthalene			-		-						A		A
2-Chloronaphthalene				-	-	*		*	*				
Acenaphthylene			-	-	-		-	*	*	-			
Acenaphthene													
Dimethyl phthalate	-	*	-		-	*	-	*	*				
2,6-Dinitrotoluene			-			*				-			
Fluorene			-		-	*							
4-Chlorophenyl phenyl ether													
Diethyl phthalate			-	-	-	*							
2,4-Dinitrotoluene			-			*			*	-			
1,2-Diphenylhydrazine			-			*							
N-Nitrosodiphenylamine													
Hexachlorobenzene		*		-	-	*	-		*	-			
4-Bromophenyl phenyl ether													
Phenanthrene	-	*	-	-	-	*	-	*	*				
Anthracene													
Di-n-butyl phthalate	A	A	A	B	A		-		*		A		
Fluoranthene	-		-	-	-	*	-						
Pyrene			A				-			-	-		
Benzidine			-			*			*	-			-
Butyl benzyl phthalate					-		-			-	A		
Bis(2-ethylhexyl)phthalate	A	B	A	-	-		A	A	*	A	B	A	
Chrysene								*					
Benz(a)anthracene					-		-						
3,3-Dichlorobenzidine	-						-		*	-	-		
Di-n-octyl phthalate					-								
Benzo(b)fluoranthene					-		-				-		
Benzo(k)fluoranthene							-						
Benzo(a)pyrene					-								
Indeno(1,2,3-c,d)pyrene			-		-		-		*				
Dibenzo(a,h)anthracene													
Benzo(g,h,i)perylene													
Phenol							B	B	B				
2-Chlorophenol													
2,4-Dimethylphenol													
2-Nitrophenol													
2,4-Dichlorophenol													
p-Chloro-m-cresol													
2,4,6-Trichlorophenol													
2,4-Dinitrophenol				A									
4-Nitrophenol			A						A				
4,6-Dinitro-o-cresol				A			A						
Pentachlorophenol			A										

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
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4. concentration ranges:
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5. + = compounds not separated by GC methodology

Table D4. Dow , 1979. Organic data.

Compound	Service Water			3rd. St. Sewer		
	019	041	086[2]	024	046[2]	091[1]
Methylene chloride						
Trichlorofluoromethane	A			-		
1,1-Dichloroethylene						
1,1-Dichloroethane			A			
Trans-1,2-dichloroethylene						
Chloroform				-		
1,2-Dichloroethane	A	A	A			A
1,1,1-Trichloroethane			A			A
Carbontetrachloride		A		B		A
Dichlorobromomethane }+						
Bis(2-chloromethyl)ether }+						
1,2-Dichloropropane						
Trans-1,3-dichloropropylene	A					
Trichloroethylene }+						
Chlorodibromomethane }+				-		*
1,1,2-Trichloroethane }+						
Cis-1,3-dichloropropene }+						
Benzene }+	A			B		
2-Chloroethylvinylether }+						
Bromoform			A			*
1,1,2,2-Tetrachloroethane }+						*
Tetrachloroethylene }+	A	A	A	A		A
Toluene				-		*
Chlorobenzene				-		*
Ethylbenzene				-		*
1,3-Dichlorobenzene						
1,4-Dichlorobenzene						
Hexachloroethane						
1,2-Dichlorobenzene						
Bis(2-chloroisopropyl)ether						
Nitrobenzene					*	
N-Nitroso-di-n-propylamine						
Bis(2-chloroethoxy)methane						
Hexachlorobutadiene				-	*	
1,2,4-Trichlorobenzene				-	*	
Naphthalene					*	
2-Chloronaphthalene				-	*	
Acenaphthylene						
Acenaphthene				-	*	
Dimethyl phthalate	-				*	
2,6-Dinitrotoluene						
Fluorene }+						
4-Chlorophenyl phenyl ether }+						
Diethyl phthalate }+				-		
2,4-Dinitrotoluene }+				B		
1,2-Diphenylhydrazine				-	*	
N-Nitrosodiphenylamine }+						
Hexachlorobenzene }+			*	-		
4-Bromophenyl phenyl ether }+						
Phenanthrene }+			*			
Anthracene }+						
Di-n-butyl phthalate						
Fluoranthene					*	
Pyrene				-		
Benzidine			*		*	
Butyl benzyl phthalate				-	*	
Bis(2-ethylhexyl)phthalate	A	A	A	-	*	
Chrysene						
Benz(a)anthracene						
3,3-Dichlorobenzidine		-				
Di-n-octyl phthalate	A			-		
Benzo(b)fluoranthene }+						
Benzo(k)fluoranthene }+						
Benzo(a)pyrene					*	
Indeno(1,2,3-c,d)pyrene }+						-
Dibenzo(a,h)anthracene }+						
Benzo(g,h,i)perylene						
Phenol				A	A	
2-Chlorophenol				A		
2,4-Dimethylphenol }+						
2-Nitrophenol }+						
2,4-Dichlorophenol						
p-Chloro-m-cresol						
2,4,6-Trichlorophenol				B		
2,4-Dinitrophenol						
4-Nitrophenol						
4,6-Dinitro-o-cresol						
Pentachlorophenol						

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Compound	Acid Tile Drain			42" Sewer				48" Sewer			54" Sluice		
		2		2	2			2	2		2		2
	023	045	087	020	042	088	0140	021	043	089	022	044	090
Methylene chloride	B	B	B			B	B						
Trichlorofluoromethane											A		
1,1-Dichloroethylene		B	A	A	A	A	A					A	
1,1-Dichloroethane	C	C	B	B	B	B	A	A	B	B		A	
Trans-1,2-dichloroethylene					A	A							
Chloroform	C	B	B	A	A	B		A	A	A	A	A	A
1,2-Dichloroethane	D	C	C	B	C	B	B	B	B	A	A	B	A
1,1,1-Trichloroethane		B	B		B	B		A					
Carbontetrachloride	C	B	C	B	B	B		A	B	B	A	A	A
Dichlorobromomethane +													
Bis(2-chloromethyl)ether +	C		A										
1,2-Dichloropropane		C	B	B	B	B	B	B	B	B	B	B	B
Trans-1,3-dichloropropylene													
Trichloroethylene +													
Chlorodibromomethane +	C	C	A	B	B	A	A	A	A	A	A	A	
1,1,2-Trichloroethane +													
Cis-1,3-dichloropropene +													
Benzene +	C	A	A	C	B	C	C	B	B	B		B	
2-Chloroethylvinylether +													
Bromoform	C	A	B	C	B	C	B	B	B	B	A	A	A
1,1,2,2-Tetrachloroethane +													
Tetrachloroethylene +	D	B	E	B	A	A	A	A	B	B	A	B	A
Toluene		B	A										
Chlorobenzene						A				A			
Ethylbenzene		A	B										
1,3-Dichlorobenzene													
1,4-Dichlorobenzene													
Hexachloroethane	A	A											
1,2-Dichlorobenzene													
Bis(2-chloroisopropyl)ether		B	B		*	A		A		A	A	A	A
Nitrobenzene		B	B		*								
N-Nitroso-di-n-propylamine													
Bis(2-chloroethoxy)methane													
Hexachlorobutadiene	A	B	A										
1,2,4-Trichlorobenzene			-										
Naphthalene		A	C										
2-Chloronaphthalene			-										
Acenaphthylene						-							
Acenaphthene			A										
Dimethyl phthalate			-				-						
2,6-Dinitrotoluene		*											
Fluorene +													
4-Chlorophenyl phenyl ether +			-				-						
Diethyl phthalate +			-										
2,4-Dinitrotoluene +													
1,2-Diphenylhydrazine		*											
N-Nitrosodiphenylamine +													
Hexachlorobenzene +	-	*	-			A	A			A			
4-Bromophenyl phenyl ether +													
Phenanthrene +							-						
Anthracene +													
Di-n-butyl phthalate			B				B						A
Fluoranthene			A				-						
Pyrene			A				-						
Benzidine		*	-		*				*	-		-	
Butyl benzyl phthalate													
Bis(2-ethylhexyl)phthalate	B	B	B		*		A	A	*		A	A	
Chrysene							-						
Benz(a)anthracene							-		*				
3,3-Dichlorobenzidine		*	-	*	*					-		-	
Di-n-octyl phthalate							A	A					
Benzo(b)fluoranthene +							-						
Benzo(k)fluoranthene +													
Benzo(a)pyrene							-		*	-			
Indeno(1,2,3-c,d)pyrene +						-							
Dibenzo(a,h)anthracene +													
Benzo(g,h,i)perylene													
Phenol													
2-Chlorophenol													
2,4-Dimethylphenol +													
2-Nitrophenol +													
2,4-Dichlorophenol			A										
p-Chloro-m-cresol													
2,4,6-Trichlorophenol													
2,4-Dinitrophenol			A										
4-Nitrophenol													
4,6-Dinitro-o-cresol													
Pentachlorophenol													

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5. + = compounds not separated by GC methodology

Compound	Service Water			Raw			Treated			Final			
	025[2]	037	095	026[2]	039	097	027	040	098[2]	0157	028	038	096
Methylene chloride				C	C	C			C	C			
Trichlorofluoromethane				A	A		A						
1,1-Dichloroethylene													
1,1-Dichloroethane		A		B		B						A	
Trans-1,2-dichloroethylene	B	B				A				C	B		
Chloroform		A	B	A	C	C	B	B	C		A	A	B
1,2-Dichloroethane	A	A	A	A	B	B		A		A	A	B	A
1,1,1-Trichloroethane				A	A	A	A	B	A				
Carbontetrachloride		A	A			A			A				A
Dichlorobromomethane }+													
Bis(2-chloromethyl)ether }+													
1,2-Dichloropropane		A	A									A	A
Trans-1,3-dichloropropylene				B	B		A	B	A	A			
Trichloroethylene }+													
Chlorodibromomethane }+				A	A	A	A	A		A		A	
1,1,2-Trichloroethane }+													
Cis-1,3-dichloropropene }+													
Benzene }+		A	A	D	B	D							A
2-Chloroethylvinylether }+													
Bromoform		A	A	B		A	A	A	A	A		A	A
1,1,2,2-Tetrachloroethane }+													
Tetrachloroethylene }+		A	A	A	B	B	C	B	B	A		A	A
Toluene				C	B	B	A	A	A	A			
Chlorobenzene			A	B		A		A		A			A
Ethylbenzene				B	A	B							
1,3-Dichlorobenzene				*	-	-			*		-		
1,4-Dichlorobenzene				*									
Hexachloroethane				*	-								
1,2-Dichlorobenzene													
Bis(2-chloroisopropyl)ether					-								
Nitrobenzene					-	-		-					
N-Nitroso-di-n-propylamine					-								
Bis(2-chloroethoxy)methane					-								
Hexachlorobutadiene				*		-		-	*	-	-		
1,2,4-Trichlorobenzene				*	-	-		-	*				
Naphthalene				B	C	C			B	C			
2-Chloronaphthalene				*	-	-		-	*	-	-		
Acenaphthylene				A	B	B	A	C	A	C	A		
Acenaphthene				*	-	-			*	-			
Dimethyl phthalate				*	-	-	-	-	*	-	-	-	-
2,6-Dinitrotoluene					-	-		-					
Fluorene }+				C	C	C	A		B	C	B		
4-Chlorophenyl phenyl ether }+													
Diethyl phthalate }+				*	-	-	-	-		-	-		
2,4-Dinitrotoluene						-	-	-					-
1,2-Diphenylhydrazine					-	-	-	-		-	-		
N-Nitrosodiphenylamine }+				A									
Hexachlorobenzene }+				*	-	-	-	-	*	-	-		-
4-Bromophenyl phenyl ether }+													
Phenanthrene }+				C	B	C	B	B	A	C	A		
Anthracene }+													
Di-n-butyl phthalate				*	-	-	-		*	-			-
Fluoranthene				B	B	B	B	B		C	A		
Pyrene				C	B	B	A	B		C	A		
Benzidine			-		-	-	-				-	-	-
Butyl benzyl phthalate		-		*	-	-	-			-			
Bis(2-ethylhexyl)phthalate	*	-	-	*	-	-	-	-			-	-	-
Chrysene				A		A	A						
Benz(a)anthracene				B	A					-			
3,3-Dichlorobenzidine		-				-	-				-	-	
Di-n-octyl phthalate				*						-			
Benzo(b)fluoranthene }4													
Benzo(k)fluoranthene }4													
Benzo(a)pyrene										-			
Indeno(1,2,3-c,d)pyrene }+													
Dibenzo(a,h)anthracene }+													
Benzo(g,h,i)perylene													
Phenol				D									
2-Chlorophenol													
2,4-Dimethylphenol }+											C		
2-Nitrophenol }+													
2,4-Dichlorophenol				D									
p-Chloro-m-cresol													
2,4,6-Trichlorophenol						B							
2,4-Dinitrophenol									B	A	A		
4-Nitrophenol											A		A
4,6-Dinitro-o-cresol									B				
Pentachlorophenol									B				

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5. + = compounds not separated by GC methodology

Compound	Service Water			Biox. Unit	Cooling Water	Final (Comp.)	
		2					2
	069	0110	0123	070	070a	0111	0124
Methylene chloride							
Trichlorofluoromethane					A		
1,1-Dichloroethylene							
1,1-Dichloroethane							
Trans-1,2-dichloroethylene					B		B
Chloroform	B						
1,2-Dichloroethane		A	A	A	A	A	A
1,1,1-Trichloroethane							
Carbontetrachloride	A	A	A		A	A	A
Dichlorobromomethane +							
Bis(2-chloromethyl)ether +							
1,2-Dichloropropane		A		A		A	
Trans-1,3-dichloropropylene				B			
Trichloroethylene +							
Chlorodibromomethane +							
1,1,2-Trichloroethane +							
Cis-1,3-dichloropropene +							
Benzene +				B	A		
2-Chloroethylvinylether +							
Bromoform					A		
1,1,2,2-Tetrachloroethane +							
Tetrachloroethylene +		A	A			A	A
Toluene							
Chlorobenzene				A			
Ethylbenzene							
1,3-Dichlorobenzene							
1,4-Dichlorobenzene							
Hexachloroethane							
1,2-Dichlorobenzene							
Bis(2-chloroisopropyl)ether							
Nitrobenzene							
N-Nitroso-di-n-propylamine							
Bis(2-chloroethoxy)methane							
Hexachlorobutadiene							
1,2,4-Trichlorobenzene							
Naphthalene							
2-Chloronaphthalene				B			
Acenaphthylene				B			
Acenaphthene				B			
Dimethyl phthalate				B			
2,6-Dinitrotoluene							
Fluorene +				B			
4-Chlorophenyl phenyl ether +				B			
Diethyl phthalate +							
2,4-Dinitrotoluene +							
1,2-Diphenylhydrazine							
N-Nitrosodiphenylamine +							
Hexachlorobenzene +				B			
4-Bromophenyl phenyl ether +							
Phenanthrene +		*					
Anthracene +							
Di-n-butyl phthalate				B		A	
Fluoranthene				A			
Pyrene				A			
Benzidine		*					*
Butyl benzyl phthalate				B			
Bis(2-ethylhexyl)phthalate	A	A	B	A		-	*
Chrysene							
Benz(a)anthracene				A			
3,3-Dichlorobenzidine		*	-				*
Di-n-octyl phthalate	A						
Benzo(b)fluoranthene +							
Benzo(k)fluoranthene +							
Benzo(a)pyrene			-				*
Indeno(1,2,3-c,d)pyrene +							
Dibenzo(a,h)anthracene +							
Benzo(g,h,i)perylene							
Phenol							
2-Chlorophenol				A			
2,4-Dimethylphenol +							
2-Nitrophenol +							
2,4-Dichlorophenol							
p-Chloro-m-cresol				B			
2,4,6-Trichlorophenol				B			
2,4-Dinitrophenol							
4-Nitrophenol						A	
4,6-Dinitro-o-cresol				B	A		
Pentachlorophenol		A					

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   - B = 10 - 100 ug/L
   - C = 100 - 1000 ug/L (1000 ug/L = 1 mg/L)
   - D = 1 - 10 mg/L
   - E = 10 - 100 mg/L
   - F = 100 - 1000 mg/L
   - * = peak identified by GC but not confirmed by GC/MS analysis
   - - = peak identified by GC but not confirmed by GC/MS analysis of samples from related sites
5. + = compounds not separated by GC methodology

Table D7. Ethyl Corp., 1979. Organic data.

Compound	Service Water (Supplied by Shell)			Neutralization Pit			Final			
		2			1		2	2		
	069	0110	0123	067	0100	0117	068	099	0118	0152
Methylene chloride				B						
Trichlorofluoromethane				-						
1,1-Dichloroethylene				-		-	-	-	-	-
1,1-Dichloroethane				-	*	-	-	-	-	-
Trans-1,2-dichloroethylene										
Chloroform	B			-				-	-	-
1,2-Dichloroethane		A	A	C				C		
1,1,1-Trichloroethane					*					
Carbontetrachloride	A	A	A		*			-		-
Dichlorobromomethane +								-		
Bis(2-chloromethyl)ether +										
1,2-Dichloropropane		A		-		-		-	-	-
Trans-1,3-dichloropropylene										
Trichloroethylene +										
Chlorodibromomethane +						A				A
1,1,2-Trichloroethane +										
Cis-1,3-dichloropropene +										
Benzene +				B	C	D	D	B	C	B
2-Chloroethylvinylether +										
Bromoform				-	*	-	-	-	-	-
1,1,2,2-Tetrachloroethane +										
Tetrachloroethylene +		A	A		*	-	-	-	-	
Toluene						A	A	A	A	A
Chlorobenzene										-
Ethylbenzene						A	A			
1,3-Dichlorobenzene										-
1,4-Dichlorobenzene										
Hexachloroethane					A			A	B	
1,2-Dichlorobenzene										
Bis(2-chloroisopropyl)ether								A		
Nitrobenzene							*			
N-Nitroso-di-n-propylamine										
Bis(2-chloroethoxy)methane										
Hexachlorobutadiene							*	A	B	B
1,2,4-Trichlorobenzene					B		*		-	
Naphthalene					B		*			
2-Chloronaphthalene					B		*	A	A	
Acenaphthylene				A	B		*			
Acenaphthene					B		*		-	
Dimethyl phthalate		*		A	B		*		-	
2,6-Dinitrotoluene					B		*		-	
Fluorene +							*		-	
4-Chlorophenyl phenyl ether +										
Diethyl phthalate +				A	B		*		A	
2,4-Dinitrotoluene +							*			
1,2-Diphenylhydrazine							*		-	
N-Nitrosodiphenylamine +								A		
Hexachlorobenzene +				A	B		*		A	
4-Bromophenyl phenyl ether +										
Phenanthrene +	-	*	-	A	A					
Anthracene +										
Di-n-butyl phthalate				B	A				A	
Fluoranthene	-	*		A	A		*			
Pyrene	-		-	A			*			
Benzidine		*					*		-	-
Butyl benzyl phthalate					A					
Bis(2-ethylhexyl)phthalate	A	A	B					B	A	B
Chrysene					A					
Benz(a)anthracene										
3,3-Dichlorobenzidine		*	-						-	-
Di-n-octyl phthalate	A				A			*	-	
Benzo(b)fluoranthene +					A					-
Benzo(k)fluoranthene +										
Benzo(a)pyrene			-		A					-
Indeno(1,2,3-c,d)pyrene +		*	-							
Dibenzo(a,h)anthracene +										
Benzo(g,h,i)perylene										
Phenol										
2-Chlorophenol										
2,4-Dimethylphenol +										
2-Nitrophenol +										
2,4-Dichlorophenol										
p-Chloro-m-cresol										
2,4,6-Trichlorophenol										
2,4-Dinitrophenol										
4-Nitrophenol						A			A	A
4,6-Dinitro-o-cresol						A			A	
Pentachlorophenol		A					A		A	

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
3. acid fraction analyzed by GC/MS
4. concentration ranges:
   - A = 1 - 10 ug/L
   - B = 10 - 100 ug/L
   - C = 100 - 1000 ug/L (1000 ug/L = 1 mg/L)
   - D = 1 - 10 mg/L
   - E = 10 - 100 mg/L
   - F = 100 - 1000 mg/L
   - * = peak identified by GC but not confirmed by GC/MS analysis
   - - = peak identified by GC but not confirmed by GC/MS analysis of samples from related sites
5. + = compounds not separated by GC methodology

Table D8. Dupont, 1979. Organic data.

Compound	Service Water			Final			
	047	0114	0121	048	0115	0122	0137[2]
Methylene chloride							
Trichlorofluoromethane	-	-					
1,1-Dichloroethylene							
1,1-Dichloroethane	A	A		A			
Trans-1,2-dichloroethylene	B			B			
Chloroform			A		A		A
1,2-Dichloroethane	B	A	A	B			B
1,1,1-Trichloroethane							
Carbontetrachloride		A	A		A	A	
Dichlorobromomethane +					A		A
Bis(2-chloromethyl)ether +							
1,2-Dichloropropane		B			A		
Trans-1,3-dichloropropylene							
Trichloroethylene +							
Chlorodibromomethane +							
1,1,2-Trichloroethane +							
Cis-1,3-dichloropropene +							
Benzene +					A		A
2-Chloroethylvinylether +							
Bromoform	A	A		A			
1,1,2,2-Tetrachloroethane +							
Tetrachloroethylene +		A	A		A	A	A
Toluene							
Chlorobenzene							
Ethylbenzene							
1,3-Dichlorobenzene			A				
1,4-Dichlorobenzene							
Hexachloroethane							
1,2-Dichlorobenzene							
Bis(2-chloroisopropyl)ether							
Nitrobenzene							
N-Nitroso-di-n-propylamine							
Bis(2-chloroethoxy)methane							
Hexachlorobutadiene							
1,2,4-Trichlorobenzene							
Naphthalene							
2-Chloronaphthalene							
Acenaphthylene							
Acenaphthene							
Dimethyl phthalate							*
2,6-Dinitrotoluene							
Fluorene +							
4-Chlorophenyl phenyl ether +							
Diethyl phthalate +							
2,4-Dinitrotoluene +							
1,2-Diphenylhydrazine							
N-Nitrosodiphenylamine +							
Hexachlorobenzene +		A			-		
4-Bromophenyl phenyl ether +							
Phenanthrene +				-			*
Anthracene +							
Di-n-butyl phthalate			A				A
Fluoranthene							*
Pyrene					-		*
Benzidine		-		-	-		
Butyl benzyl phthalate							
Bis(2-ethylhexyl)phthalate	-	-	-	-	-		
Chrysene							
Benz(a)anthracene							
3,3-Dichlorobenzidine	-	-		-	-		
Di-n-octyl phthalate			A				
Benzo(b)fluoranthene +							*
Benzo(k)fluoranthene +							
Benzo(a)pyrene							*
Indeno(1,2,3-c,d)pyrene +					-		
Dibenzo(a,h)anthracene +							
Benzo(g,h,i)perylene							
Phenol							
2-Chlorophenol							
2,4-Dimethylphenol +							
2-Nitrophenol +							
2,4-Dichlorophenol							
p-Chloro-m-cresol							
2,4,6-Trichlorophenol							
2,4-Dinitrophenol							
4-Nitrophenol		A					
4,6-Dinitro-o-cresol		A					
Pentachlorophenol		A					

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
3. acid fraction analyzed by GC/MS
4. concentration ranges:
   - A = 1 - 10 ug/L
   - B = 10 - 100 ug/L
   - C = 100 - 1000 ug/L (1000 ug/L = 1 mg/L)
   - D = 1 - 10 mg/L
   - E = 10 - 100 mg/L
   - F = 100 - 1000 mg/L
   - * = peak identified by GC but not confirmed by GC/MS analysis
   - - = peak identified by GC but not confirmed by GC/MS analysis of samples from related sites
5. + = compounds not separated by GC methodology

Table D9. Petrosar, 1979. Organic data.

Compound	Service Water			Final			
	049	062	0132	053	066	0133	0161[2]
Methylene chloride				B	B		B
Trichlorofluoromethane		-	-				-
1,1-Dichloroethylene							
1,1-Dichloroethane							
Trans-1,2-dichloroethylene	A		A				-
Chloroform				-	-	-	-
1,2-Dichloroethane	B	B			-	-	-
1,1,1-Trichloroethane							-
Carbontetrachloride			A				-
Dichlorobromomethane } +							-
Bis(2-chloromethyl)ether } +							
1,2-Dichloropropane							-
Trans-1,3-dichloropropylene							
Trichloroethylene } +							
Chlorodibromomethane } +				-	-		-
1,1,2-Trichloroethane } +							
Cis-1,3-dichloropropene } +							
Benzene } +	A	A		B	B		C
2-Chloroethylvinylether } +							
Bromoform	A	A					-
1,1,2,2-Tetrachloroethane } +							
Tetrachloroethylene } +			A	-	-	-	-
Toluene				A	A		B
Chlorobenzene							-
Ethylbenzene							
1,3-Dichlorobenzene							*
1,4-Dichlorobenzene							
Hexachloroethane							
1,2-Dichlorobenzene							
Bis(2-chloroisopropyl)ether							
Nitrobenzene							
N-Nitroso-di-n-propylamine					-		
Bis(2-chloroethoxy)methane							
Hexachlorobutadiene				-	-		*
1,2,4-Trichlorobenzene						-	*
Naphthalene					A	A	B
2-Chloronaphthalene				-	-	-	*
Acenaphthylene				A	A		A
Acenaphthene				A	A	A	A
Dimethyl phthalate			A	A	-	A	*
2,6-Dinitrotoluene				-	-	-	
Fluorene				A	A	A	A
4-Chlorophenyl phenyl ether } +							
Diethyl phthalate } +				A	A		A
2,4-Dinitrotoluene } +						-	
1,2-Diphenylhydrazine				-	-	-	
N-Nitrosodiphenylamine } +							
Hexachlorobenzene } +				B	B		*
4-Bromophenyl phenyl ether } +							
Phenanthrene } +				A	A		A
Anthracene } +							
Di-n-butyl phthalate				B	B	A	A
Fluoranthene				A	A	A	
Pyrene				B	A	A	
Benzidine	-			-	-	-	
Butyl benzyl phthalate					-		
Bis(2-ethylhexyl)phthalate	A	A	A	A	A	A	A
Chrysene							
Benz(a)anthracene							
3,3-Dichlorobenzidine	-	-		-	-		
Di-n-octyl phthalate							
Benzo(b)fluoranthene } +							
Benzo(k)fluoranthene } +							
Benzo(a)pyrene							
Indeno(1,2,3-c,d)pyrene } +		A					
Dibenzo(a,h)anthracene } +							
Benzo(g,h,i)perylene							
Phenol							A
2-Chlorophenol							
2,4-Dimethylphenol } +					A		A
2-Nitrophenol } +							
2,4-Dichlorophenol					A	A	
p-Chloro-m-cresol							
2,4,6-Trichlorophenol					A		
2,4-Dinitrophenol				B			A
4-Nitrophenol					A		A
4,6-Dinitro-o-cresol				B	B		A
Pentachlorophenol		B			B		

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
3. acid fraction analyzed by GC/MS
4. concentration ranges:
   - A = 1 - 10 ug/L
   - B = 10 - 100 ug/L
   - C = 100 - 1000 ug/L (1000 ug/L = 1 mg/L)
   - D = 1 - 10 mg/L
   - E = 10 - 100 mg/L
   - F = 100 - 1000 mg/L
   - * = peak identified by GC but not confirmed by GC/MS analysis
   - - = peak identified by GC but not confirmed by GC/MS analysis of samples from related sites
5. + = compounds not separated by GC methodology

Compound	DAF				Biox. Unit				A/C Filter			
	050 [2]	063 [2]	0134	0158 [1,2]	051	064	0136	0159 [2]	052	065	0135	0160
Methylene chloride	B	B	C	C	B		B	B	B	B	C	B
Trichlorofluoromethane	-		-		-				-	-		
1,1-Dichloroethylene												
1,1-Dichloroethane	-	-	-	*								
Trans-1,2-dichloroethylene	-		-	*					-	-	-	-
Chloroform	-	-	-	*	-	-	-		-		-	-
1,2-Dichloroethane	-	-	-	*	-		-	-	-	-	-	-
1,1,1-Trichloroethane	-	-	-	*	-		-		-	-	-	
Carbontetrachloride												-
Dichlorobromomethane + Bis(2-chloromethyl)ether												
1,2-Dichloropropane				*								
Trans-1,3-dichloropropylene	-	-	-	*				-	-		-	-
Trichloroethylene + Chlorodibromomethane + 1,1,2-Trichloroethane	-	-	-	*	-		-	-	-	-		-
Cis-1,3-dichloropropene + Benzene + 2-Chloroethylvinylether	E	E	E	E	E		B	B	C	C	D	C
Bromoform	-	-	-	*				-	-	-	-	-
1,1,2,2-Tetrachloroethane + Tetrachloroethylene	-	-	-	*	-		-	-	-	-	-	-
Toluene	C	D	D	D	B		A	B	C	B	B	B
Chlorobenzene	-	-	-	*	-		-		-	-	-	-
Ethylbenzene	C	C	C	C	A				B	B	A	B
1,3-Dichlorobenzene	*		-	*								-
1,4-Dichlorobenzene				*					-			
Hexachloroethane	*			*					-			
1,2-Dichlorobenzene	*			*					-			
Bis(2-chloroisopropyl)ether	*		-									
Nitrobenzene	*		-						-			
N-Nitroso-di-n-propylamine			-									
Bis(2-chloroethoxy)methane												
Hexachlorobutadiene	*	*	-	*				*	-		-	-
1,2,4-Trichlorobenzene	*	*	-	*		-		*	-			
Naphthalene	D	C	D	D					A		A	
2-Chloronaphthalene	*	*	-	*	-	-	-		-		-	-
Acenaphthylene	*	*	-	*			-	*	-		-	
Acenaphthene	C	B	B	C	A	A		A	A		A	B
Dimethyl phthalate	C	*	C	A			B	B	B	-	B	C
2,6-Dinitrotoluene	*	*	-				-		-		-	
Fluorene + 4-Chlorophenyl phenyl ether	B	B	C	C	A		B	A	B		A	B
Diethyl phthalate + 2,4-Dinitrotoluene	B	*	B	C			A	B	B			B
1,2-Diphenylhydrazine	*		-						-		-	
N-Nitrosodiphenylamine + Hexachlorobenzene + 4-Bromophenyl phenyl ether	*	*	-						-			
Phenanthrene + Anthracene	C	C	C	B	A		B	B	B		A	
Di-n-butyl phthalate	C	B	C	C	A		B	A	B		A	A
Fluoranthene	*	*	-	*		-	-	*		-	-	-
Pyrene	B	B	B	C			B	A	A			A
Benzidine	B	B	B	C				A	A			B
Butyl benzyl phthalate		*	-			-	-	*			-	
Bis(2-ethylhexyl)phthalate	*	*	-	*		-						-
Chrysene	C	B	B	C	B	A				A	A	A
Benz(a)anthracene	B		A	B			C					
3,3-Dichlorobenzidine		*	B	B					-			
Di-n-octyl phthalate					-	-	-				-	
Benzo(b)fluoranthene + Benzo(k)fluoranthene		A	A	B								
Benzo(a)pyrene				*								
Indeno(1,2,3-c,d)pyrene + Dibenzo(a,h)anthracene		*		*					-			
Benzo(g,h,i)perylene												
Phenol	E	D	D	E	A	A		A				B
2-Chlorophenol										B		
2,4-Dimethylphenol + 2-Nitrophenol	E	D	C	E	A	B				D		B
2,4-Dichlorophenol				C			A	A		D	A	B
p-Chloro-m-cresol								A	A		A	A
2,4,6-Trichlorophenol		C		C						C		A
2,4-Dinitrophenol												
4-Nitrophenol	C	B	A				A	A	B	C	A	A
4,6-Dinitro-o-cresol	D	B										B
Pentachlorophenol	D		B				B	B		C	B	A

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
3. acid fraction analyzed by GC/MS
4. concentration ranges:
   - A = 1 - 10 ug/L
   - B = 10 - 100 ug/L
   - C = 100 - 1000 ug/L (1000 ug/L = 1 mg/L)
   - D = 1 - 10 mg/L
   - E = 10 - 100 mg/L
   - F = 100 - 1000 mg/L
   - * = peak identified by GC but not confirmed by GC/MS analysis
   - - = peak identified by GC but not confirmed by GC/MS analysis of samples from related sites
5. + = compounds not separated by GC methodology

Compound	Service Water			Final		
	O60	O112	O119	O61	O113[2]	O120
Methylene chloride						
Trichlorofluoromethane	-	-		-	-	
1,1-Dichloroethylene						
1,1-Dichloroethane	A					
Trans-1,2-dichloroethylene				B		
Chloroform	-					
1,2-Dichloroethane	A		A	A		A
1,1,1-Trichloroethane				A		
Carbontetrachloride		A			A	
Dichlorobromomethane +						
Bis(2-chloromethyl)ether +						
1,2-Dichloropropane		A			A	
Trans-1,3-dichloropropylene						
Trichloroethylene +						
Chlorodibromomethane +						
1,1,2-Trichloroethane +						
Cis-1,3-dichloropropene +						
Benzene +						
2-Chloroethylvinylether +						
Bromoform				A		
1,1,2,2-Tetrachloroethane +						
Tetrachloroethylene +		A				
Toluene						
Chlorobenzene						
Ethylbenzene						
1,3-Dichlorobenzene						
1,4-Dichlorobenzene						
Hexachloroethane						
1,2-Dichlorobenzene						
Bis(2-chloroisopropyl)ether						
Nitrobenzene						
N-Nitroso-di-n-propylamine						
Bis(2-chloroethoxy)methane						
Hexachlorobutadiene						
1,2,4-Trichlorobenzene						
Naphthalene						
2-Chloronaphthalene						
Acenaphthylene						
Acenaphthene						
Dimethyl phthalate						
2,6-Dinitrotoluene						
Fluorene +						
4-Chlorophenyl phenyl ether +						
Diethyl phthalate +						
2,4-Dinitrotoluene +						
1,2-Diphenylhydrazine						
N-Nitrosodiphenylamine +						
Hexachlorobenzene +	A					
4-Bromophenyl phenyl ether +						
Phenanthrene +						
Anthracene +						
Di-n-butyl phthalate		A				
Fluoranthene						
Pyrene						
Benzidine	-		-		*	-
Butyl benzyl phthalate			A			
Bis(2-ethylhexyl)phthalate	A	A	B	A	A	A
Chrysene						
Benz(a)anthracene						
3,3-Dichlorobenzidine						
Di-n-octyl phthalate		A				
Benzo(b)fluoranthene +						
Benzo(k)fluoranthene +						
Benzo(a)pyrene						
Indeno(1,2,3-c,d)pyrene +						
Dibenzo(a,h)anthracene +						
Benzo(g,h,i)perylene						
Phenol						
2-Chlorophenol						
2,4-Dimethylphenol +						
2-Nitrophenol +						
2,4-Dichlorophenol						
p-Chloro-m-cresol						
2,4,6-Trichlorophenol						
2,4-Dinitrophenol						
4-Nitrophenol						
4,6-Dinitro-o-cresol						
Pentachlorophenol	A			A		

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
3. acid fraction analyzed by GC/MS
4. concentration ranges:
   - A = 1 - 10 ug/L
   - B = 10 - 100 ug/L
   - C = 100 - 1000 ug/L (1000 ug/L = 1 mg/L)
   - D = 1 - 10 mg/L
   - E = 10 - 100 mg/L
   - F = 100 - 1000 mg/L
   - * = peak identified by GC but not confirmed by GC/MS analysis
   - - = peak identified by GC but not confirmed by GC/MS analysis of samples from related sites
5. + = compounds not separated by GC methodology

Compound	Holmes Final		SRD above Fiberglas		Fiberglas Disposal		Scott Rd. Ditch					
	2			1,3	2			2,3	2	2	2	2
	0130	0144	0129	0145	0128	0146	09	036	0125	0127	0147	0148
Methylene chloride							C	C	B	B	B	
Trichlorofluoromethane		A							-			-
1,1-Dichloroethylene					B	B		-	-	-		-
1,1-Dichloroethane					C	-	B	B	A			A
Trans-1,2-dichloroethylene					B	B		-		-		
Chloroform	A	A		A	B		B	B	B	B		A
1,2-Dichloroethane					C	C	-	-	-	-	-	-
1,1,1-Trichloroethane				A	B	B	A		A		A	A
Carbontetrachloride					B		-	-	-	-	-	-
Dichlorobromomethane + Bis(2-chloromethyl)ether	A	A			B	B	-	-				-
1,2-Dichloropropane					C	C	-	-	-	-	-	-
Trans-1,3-dichloropropylene					D	D						
Trichloroethylene + Chlorodibromomethane + 1,1,2-Trichloroethane					B	B	-	-	-	-	-	-
Cis-1,3-dichloropropene + Benzene + 2-Chloroethylvinylether	A	A			D	D	C	C	B	C	B	C
Bromoform						B	-	-	-	-	-	-
1,1,2,2-Tetrachloroethane + Tetrachloroethylene				*	D	D	B	B	B	C	B	B
Toluene		A		A			A	A	A	A	A	A
Chlorobenzene					B	A	-	-	-	-		
Ethylbenzene					B	B						
1,3-Dichlorobenzene					B						*	*
1,4-Dichlorobenzene					A							
Hexachloroethane				A	D	B		B	A	B	*	
1,2-Dichlorobenzene											*	
Bis(2-chloroisopropyl)ether				A	*	-		A		A	*	
Nitrobenzene					C						A	A
N-Nitroso-di-n-propylamine								*				
Bis(2-chloroethoxy)methane												
Hexachlorobutadiene				B	C	C		B	B		A	A
1,2,4-Trichlorobenzene		-			A	B				*	*	*
Naphthalene					A	A				A		A
2-Chloronaphthalene		-				-						
Acenaphthylene						-	B	*				
Acenaphthene						-						
Dimethyl phthalate	*	-	-			-	C		*			
2,6-Dinitrotoluene			-			-	-					
Fluorene + 4-Chlorophenyl phenyl ether	*					A	C					
Diethyl phthalate + 2,4-Dinitrotoluene	*	-				A	B					
1,2-Dipbenylhydrazine		-				-	-	*				
N-Nitrosodiphenylamine + Hexachlorobenzene + 4-Bromophenyl phenyl ether	*	-	A	A	A	A	C	A	A	A	A	A
Phenanthrene + Anthracene	*	-	A				B			A		
Di-n-butyl phthalate		A	A			A	B				A	A
Fluoranthene	*	-				-	B	*				
Pyrene	*	-		A		A		*				A
Benzidine		-		-		-	-				*	
Butyl benzyl phthalate	*	-	A			A	B		A		*	
Bis(2-ethylhexyl)phthalate	B	A	A	A	B		C	A		B	A	*
Chrysene												
Benz(a)anthracene	*											
3,3-Dichlorobenzidine		-				-	-					
Di-n-octyl phthalate							B	B				
Benzo(b)fluoranthene + Benzo(k)fluoranthene						-		*				
Benzo(a)pyrene								*				
Indeno(1,2,3-c,d)pyrene + Dibenzo(a,h)anthracene								*				
Benzo(g,h,i)perylene												
Phenol	B		C						-	-		
2-Chlorophenol					A							
2,4-Dimethylphenol + 2-Nitrophenol										-		-
2,4-Dichlorophenol			A					A				
p-Chloro-m-cresol												
2,4,6-Trichlorophenol	A		B		B			*				
2,4-Dinitrophenol			A		B							
4-Nitrophenol		A			B	B		*		-		
4,6-Dinitro-o-cresol		A			B	B		*			-	-
Pentachlorophenol								*				

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
3. acid fraction analyzed by GC/MS
4. concentration ranges:
   - A = 1 - 10 ug/L
   - B = 10 - 100 ug/L
   - C = 100 - 1000 ug/L (1000 ug/L = 1 mg/L)
   - D = 1 - 10 mg/L
   - E = 10 - 100 mg/L
   - F = 100 - 1000 mg/L
   - * = peak identified by GC but not confirmed by GC/MS analysis
   - - = peak identified by GC but not confirmed by GC/MS analysis of samples from related sites
5. + = compounds not separated by GC methodology

Table D11(cont.). Township Ditch, 1979. Organic data.

Compound	IOEL Drainage[1] 0126	at RR Tracks[1] 0131	Fiber-glas 0138	Cabot Carbon 0139	Polysar Ditch In[2] 034	Polysar Ditch In[2] 084	Polysar Ditch Out[2] 07	Polysar Ditch Out[2] 035	Polysar Ditch Out[2] 085
Methylene chloride		B							
Trichlorofluoromethane		-							
1,1-Dichloroethylene	*	-							
1,1-Dichloroethane	A	B							
Trans-1,2-dichloroethylene	*			A	A	A			
Chloroform	A	B	A				A		A
1,2-Dichloroethane	A	-				A			
1,1,1-Trichloroethane		A							
Carbontetrachloride		-				A			
Dichlorobromomethane + Bis(2-chloromethyl)ether									
1,2-Dichloropropane	A	-				A			
Trans-1,3-dichloropropylene									
Trichloroethylene + Chlorodibromomethane + 1,1,2-Trichloroethane	A	-			A	A			
Cis-1,3-dichloropropene + Benzene + 2-Chloroethylvinylether	B	C			A	B			A
Bromoform	*	-	A		A	B	A		B
1,1,2,2-Tetrachloroethane + Tetrachloroethylene	B	B			A	A			A
Toluene	*	A			A			A	
Chlorobenzene		-				A		A	B
Ethylbenzene									
1,3-Dichlorobenzene									
1,4-Dichlorobenzene							*		
Hexachloroethane						A			
1,2-Dichlorobenzene									
Bis(2-chloroisopropyl)ether						A			
Nitrobenzene						A			
N-Nitroso-di-n-propylamine									
Bis(2-chloroethoxy)methane									
Hexachlorobutadiene	-				A				
1,2,4-Trichlorobenzene						A			-
Naphthalene									
2-Chloronaphthalene	-						*		-
Acenaphthylene	A								
Acenaphthene									
Dimethyl phthalate	-				A		A	B	
2,6-Dinitrotoluene	-						*		-
Fluorene									
4-Chlorophenyl phenyl ether									
Diethyl phthalate + 2,4-Dinitrotoluene	-								-
1,2-Diphenylhydrazine						A			-
N-Nitrosodiphenylamine + Hexachlorobenzene + 4-Bromophenyl phenyl ether	A			A		A	*		
Phenanthrene + Anthracene	A					A	A	B	B
Di-n-butyl phthalate	-							A	A
Fluoranthene									A
Pyrene						A			
Benzidine	-					*			-
Butyl benzyl phthalate	-						*		-
Bis(2-ethylhexyl)phthalate	-		A	A		A	B	B	A
Chrysene									
Benz(a)anthracene							A	A	
3,3-Dichlorobenzidine	-		-			*	*		-
Di-n-octyl phthalate	-		-						
Benzo(b)fluoranthene + Benzo(k)fluoranthene	-		-				*		
Benzo(a)pyrene	-								
Indeno(1,2,3-c,d)pyrene + Dibenzo(a,h)anthracene							*		-
Benzo(g,h,i)perylene	-						*		
Phenol									
2-Chlorophenol									
2,4-Dimethylphenol									
2-Nitrophenol									
2,4-Dichlorophenol									
p-Chloro-m-cresol									
2,4,6-Trichlorophenol									
2,4-Dinitrophenol									
4-Nitrophenol		-				A			
4,6-Dinitro-o-cresol		-							
Pentachlorophenol		-							

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
3. acid fraction analyzed by GC/MS
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5. + = compounds not separated by GC methodology

Compound	IOEL 054	IOEL 072	IOEL 0101[2]	Polysar 01	Polysar 029[2]	Polysar 079	Dow 019	Dow 041	Dow 086[2]	Sun Oil 025[2]	Sun Oil 037	Sun Oil 05
Methylene chloride												
Trichlorofluoromethane							A					
1,1-Dichloroethylene												
1,1-Dichloroethane									A		A	
Trans-1,2-dichloroethylene										B	B	
Chloroform	B		A		A	A					A	
1,2-Dichloroethane				A	A	A	A	A	A	A	A	
1,1,1-Trichloroethane									A			
Carbontetrachloride								A			A	
Dichlorobromomethane + Bis(2-chloromethyl)ether					A							
1,2-Dichloropropane											A	
Trans-1,3-dichloropropylene							A					
Trichloroethylene + Chlorodibromomethane + 1,1,2-Trichloroethane												
Cis-1,3-dichloropropene + Benzene + 2-Chloroethylvinylether							A				A	
Bromoform						A			A		A	
1,1,2,2-Tetrachloroethane + Tetrachloroethylene							A	A	A		A	
Toluene												
Chlorobenzene						A						
Ethylbenzene												
1,3-Dichlorobenzene												
1,4-Dichlorobenzene												
Hexachloroethane												
1,2-Dichlorobenzene												
Bis(2-chloroisopropyl)ether												
Nitrobenzene												
N-Nitroso-di-n-propylamine												
Bis(2-chloroethoxy)methane												
Hexachlorobutadiene												
1,2,4-Trichlorobenzene												
Naphthalene												
2-Chloronaphthalene				-						*		
Acenaphthylene												
Acenaphthene					*							
Dimethyl phthalate		-		-	*		-	-				
2,6-Dinitrotoluene												
Fluorene + 4-Chlorophenyl phenyl ether				-								
Diethyl phthalate + 2,4-Dinitrotoluene				-								
1,2-Diphenylhydrazine				-								
N-Nitrosodiphenylamine + Hexachlorobenzene + 4-Bromophenyl phenyl ether			*	-	*				*			
Phenanthrene + Anthracene				-	*				*	*		
Di-n-butyl phthalate						B						
Fluoranthene			*		*					*		
Pyrene			*							*		
Benzidine		-							*			
Butyl benzyl phthalate		-	*							*	-	
Bis(2-ethylhexyl)phthalate	-	-	*	A	C		A	A	A	*	-	
Chrysene												
Benz(a)anthracene				-	*					*		
3,3-Dichlorobenzidine				-				-			-	
Di-n-octyl phthalate			*		*		A			*		
Benzo(b)fluoranthene + Benzo(k)fluoranthene			*		*							
Benzo(a)pyrene			*		*							
Indeno(1,2,3-c,d)pyrene + Dibenzo(a,h)anthracene		-	*	-	*				*			
Benzo(g,h,i)perylene		-										
Phenol												
2-Chlorophenol												
2,4-Dimethylphenol + 2-Nitrophenol												
2,4-Dichlorophenol												
p-Chloro-m-cresol												
2,4,6-Trichlorophenol												
2,4-Dinitrophenol	A											
4-Nitrophenol												
4,6-Dinitro-o-cresol				A								
Pentachlorophenol												

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
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4. concentration ranges:
   - A = 1 - 10 ug/L
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5. + = compounds not separated by GC methodology

Table D12(cont.). Intake. 1979 Organic data.

Compound	Shell Oil			Dupont			Petrosar			C.I.L.		
	069	0110	0123[2]	047	0114	0121	049	062	0132	060	0112	011
Methylene chloride												
Trichlorofluoromethane										A		
1,1-Dichloroethylene												
1,1-Dichloroethane				A	A					A		
Trans-1,2-dichloroethylene				B			A		A			
Chloroform	B					A				A		
1,2-Dichloroethane		A	A	B	A	A	B	B		A		
1,1,1-Trichloroethane												
Carbontetrachloride	A	A	A		A	A			A		A	
Dichlorobromomethane + Bis(2-chloromethyl)ether												
1,2-Dichloropropane		A			B						A	
Trans-1,3-dichloropropylene												
Trichloroethylene + Chlorodibromomethane + 1,1,2-Trichloroethane												
Cis-1,3-dichloropropene + Benzene + 2-Chloroethylvinylether							A	A				
Bromoform				A	A		A	A				
1,1,2,2-Tetrachloroethane + Tetrachloroethylene		A	A		A	A			A		A	
Toluene												
Chlorobenzene												
Ethylbenzene												
1,3-Dichlorobenzene						A						
1,4-Dichlorobenzene												
Hexachloroethane												
1,2-Dichlorobenzene												
Bis(2-chloroisopropyl)ether												
Nitrobenzene												
N-Nitroso-di-n-propylamine												
Bis(2-chloroethoxy)methane												
Hexachlorobutadiene												
1,2,4-Trichlorobenzene												
Naphthalene												
2-Chloronaphthalene												
Acenaphthylene												
Acenaphthene												
Dimethyl phthalate		*							A			
2,6-Dinitrotoluene												
Fluorene + 4-Chlorophenyl phenyl ether												
Diethyl phthalate + 2,4-Dinitrotoluene												
1,2-Diphenylhydrazine												
N-Nitrosodiphenylamine + Hexachlorobenzene + 4-Bromophenyl phenyl ether					A					A		
Phenanthrene + Anthracene	-	*	-									
Di-n-butyl phthalate						A					A	
Fluoranthene	-		-									
Pyrene	-		-									
Benzidine		*			-		-			-		
Butyl benzyl phthalate												
Bis(2-ethylhexyl)phthalate	A	A	B	-	-	-	A	A	A	A	A	
Chrysene												
Benz(a)anthracene												
3,3-Dichlorobenzidine		*	-	-	-		-	-				
Di-n-octyl phthalate	A					A					A	
Benzo(b)fluoranthene + Benzo(k)fluoranthene												
Benzo(a)pyrene			-									
Indeno(1,2,3-c,d)pyrene + Dibenzo(a,h)anthracene		*	-					A				
Benzo(g,h,i)perylene												
Phenol												
2-Chlorophenol												
2,4-Dimethylphenol + 2-Nitrophenol												
2,4-Dichlorophenol												
p-Chloro-m-cresol												
2,4,6-Trichlorophenol												
2,4-Dinitrophenol												
4-Nitrophenol					A			-		A		
4,6-Dinitro-o-cresol					A							
Pentachlorophenol		A			A			-		A		

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
3. acid fraction analyzed by GC/MS
4. concentration ranges:
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5. + = compounds not separated by GC methodology

Compoumd	Pt. Edward O104	Sarnia O143	Corruna O105
Methylene chloride	B		
Trichlorofluoromethane	-		-
1,1-Dichloroethylene			
1,1-Dichloroethane	B		
Trans-1,2-dichloroethylene		A	
Chloroform	B		A
1,2-Dichloroethane	B		
1,1,1-Trichloroethane	A		
Carbontetrachloride	A		
Dichlorobromomethane + Bis(2-chloromethyl)ether			A
1,2-Dichloropropane			
Trans-1,3-dichloropropylene			-
Trichloroethylene + Chlorodibromomethane + 1,1,2-Trichloroethane	A	A	
Cis-1,3-dichloropropene + Benzene + 2-Chloroethylvinylether	C		
Bromoform	A		
1,1,2,2-Tetrachloroethane + Tetrachloroethylene	A		A
Toluene	C		
Chlorobenzene			
Ethylbenzene	A		
1,3-Dichlorobenzene			
1,4-Dichlorobenzene			
Hexachloroethane			
1,2-Dichlorobenzene			
Bis(2-chloroisopropyl)ether			
Nitrobenzene			
N-Nitroso-di-n-propylamine			
Bis(2-chloroethoxy)methane			
Hexachlorobutadiene			
1,2,4-Trichlorobenzene			
Naphthalene		A	
2-Chloronaphthalene	B		
Acenaphthylene	B		
Acenaphthene			
Dimethyl phthalate	A		
2,6-Dinitrotoluene	A		
Fluorene + 4-Chlorophenyl phenyl ether	A		
Diethyl phthalate + 2,4-Dinitrotoluene	B	A	
1,2-Diphenylhydrazine	B		
N-Nitrosodiphenylamine + Hexachlorobenzene + 4-Bromophenyl phenyl ether	B		A
Phenanthrene + Anthracene	C		
Di-n-butyl phthalate	B		
Fluoranthene			
Pyrene	A		
Benzidine			-
Butyl benzyl phthalate	B		
Bis(2-ethylhexyl)phthalate	B		A
Chrysene	B		
Benz(a)anthracene			
3,3-Dichlorobenzidine	-		-
Di-n-octyl phthalate		A	
Benzo(b)fluoranthene + Benzo(k)fluoranthene	C		
Benzo(a)pyrene	B		
Indeno(1,2,3-c,d)pyrene + Dibenzo(a,h)anthracene			
Benzo(g,h,i)perylene	A		
Phenol	B		
2-Chlorophenol			
2,4-Dimethylphenol + 2-Nitrophenol			
2,4-Dichlorophenol			
p-Chloro-m-cresol			
2,4,6-Trichlorophenol	B	B	
2,4-Dinitrophenol	B		
4-Nitrophenol	B	A	
4,6-Dinitro-o-cresol			
Pentachlorophenol	A	B	

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APPENDIX E

1980 ORGANIC DATA

Compound	Service Water						Final					
	[2] E7	E8	E11	E12	E13	E35	[1,2,3] E9	[2] E10	E14	E15	E16	E36
Methylene chloride	B											
Trichlorofluoromethane						-		-		-	-	-
1,1-Dichloroethylene												
1,1-Dichloroethane												
Trans-1,2-dichloroethylene												
Chloroform	A						A		A	A		
1,2-Dichloroethane	A											
1,1,1-Trichloroethane												
Carbontetrachloride	A											
Dichlorobromomethane +												
Bis(2-chloromethyl)ether +												
1,2-Dichloropropane												
Trans-1,3-dichloropropylene									-			
Trichloroethylene +												
Chlorodibromomethane +												
1,1,2-Trichloroethane +												
Cis-1,3-dichloropropene +												
Benzene +							B		A			
2-Chloroethylvinylether +												
Bromoform												
1,1,2,2-Tetrachloroethane +												
Tetrachloroethylene +												
Toluene									A			
Chlorobenzene							*	-	-	-		
Ethylbenzene												
1,3-Dichlorobenzene									-			
1,4-Dichlorobenzene									-		-	
Hexachloroethane												
1,2-Dichlorobenzene												
Bis(2-chloroisopropyl)ether												
Nitrobenzene								*	-			
N-Nitroso-di-n-propylamine												
Bis(2-chloroethoxy)methane												
Hexachlorobutadiene												
1,2,4-Trichlorobenzene									-		-	
Naphthalene								*			-	-
2-Chloronaphthalene							*	*	-	-	-	-
Acenaphthylene							*	*	-	-	-	-
Acenaphthene								*	-	-	-	-
Dimethyl phthalate							*	*	-	-	-	
2,6-Dinitrotoluene							*	*	-	-	-	-
Fluorene +							*	*	-	-	-	-
4-Chlorophenyl phenyl ether +												
Diethyl phthalate +							*	*			-	-
2,4-Dinitrotoluene +								*				
1,2-Diphenylhydrazine							*	*	-	-	-	-
N-Nitrosodiphenylamine +												
Hexachlorobenzene +		-					*	*	-	-	-	-
4-Bromophenyl phenyl ether +												
Phenanthrene +							*	*	-		-	-
Anthracene +												
Di-n-butyl phthalate						-		*	-	-	-	-
Fluoranthene		-		-				*	-		-	-
Pyrene	*	-						*	-	-	-	-
Benzidine			-	-	-			*			-	
Butyl benzyl phthalate		-							-			
Bis(2-ethylhexyl)phthalate	*	-	-	-	-	-		*		-	-	-
Chrysene									-			
Benz(a)anthracene								*	-			
3,3-Dichlorobenzidine	*	-		-	-				-	-	-	-
Di-n-octyl phthalate									-			-
Benzo(b)fluoranthene +		-							-	-	-	-
Benzo(k)fluoranthene +												
Benzo(a)pyrene										-		
Indeno(1,2,3-c,d)pyrene +												-
Dibenzo(a,h)anthracene +												
Benzo(g,h,i)perylene								*				-
Phenol												
2-Chlorophenol												
2,4-Dimethylphenol +							A		A	A	A	A
2-Nitrophenol +												
2,4-Dichlorophenol												
p-Chloro-m-cresol												
2,4,6-Trichlorophenol												
2,4-Dinitrophenol												
4-Nitrophenol												
4,6-Dinitro-o-cresol												
Pentachlorophenol												

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5. + = compounds not separated by GC methodology

Compound	Service Water				Ditch In				Ditch Out			
			2		1,2,3				1,2		2,3	2,3
	E23	E24	E43	E44	E25	E26	E45	E46	E27	E28	E47	E48
Methylene chloride	B										B	
Trichlorofluoromethane			-	-								
1,1-Dichloroethylene												
1,1-Dichloroethane								-				
Trans-1,2-dichloroethylene												
Chloroform					A							
1,2-Dichloroethane	A				*		-					
1,1,1-Trichloroethane												
Carbontetrachloride	A											
Dichlorobromomethane + Bis(2-chloromethyl)ether												
1,2-Dichloropropane												
Trans-1,3-dichloropropylene												
Trichloroethylene + Chlorodibromomethane + 1,1,2-Trichloroethane					A	A	A	A				
Cis-1,3-dichloropropene + Benzene + 2-Chloroethylvinylether					A	A	B	C	A			
Bromoform	A	A	A	A	*	-	-	-	*	-	-	-
1,1,2,2-Tetrachloroethane + Tetrachloroethylene					B	A	B	A	A		A	A
Toluene											A	
Chlorobenzene								-	*	-	-	-
Ethylbenzene												
1,3-Dichlorobenzene												
1,4-Dichlorobenzene												
Hexachloroethane												
1,2-Dichlorobenzene												
Bis(2-chloroisopropyl)ether												*
Nitrobenzene						-						
N-Nitroso-di-n-propylamine												*
Bis(2-chloroethoxy)methane												
Hexachlorobutadiene												
1,2,4-Trichlorobenzene							-					
Naphthalene												
2-Chloronaphthalene												
Acenaphthylene												
Acenaphthene												
Dimethyl phthalate												
2,6-Dinitrotoluene				-								
Fluorene + 4-Chlorophenyl phenyl ether												*
Diethyl phthalate + 2,4-Dinitrotoluene												*
1,2-Diphenylhydrazine												*
N-Nitrosodiphenylamine + Hexachlorobenzene + 4-Bromophenyl phenyl ether												
Phenanthrene + Anthracene					A							*
Di-n-butyl phthalate					A						A	A
Fluoranthene												
Pyrene												A
Benzidine												
Butyl benzyl phthalate			*					A		A	A	
Bis(2-ethylhexyl)phthalate	-	-	*					C	A	A	A	A
Chrysene			*									
Benz(a)anthracene			*					-				
3,3-Dichlorobenzidine	-	-		-	*	-	-		*			*
Di-n-octyl phthalate			*		A							
Benzo(b)fluoranthene + Benzo(k)fluoranthene			*		A							
Benzo(a)pyrene												
Indeno(1,2,3-c,d)pyrene + Dibenzo(a,h)anthracene												
Benzo(g,h,i)perylene												
Phenol												
2-Chlorophenol												
2,4-Dimethylphenol + 2-Nitrophenol												
2,4-Dichlorophenol												
p-Chloro-m-cresol												
2,4,6-Trichlorophenol												
2,4-Dinitrophenol												
4-Nitrophenol												
4,6-Dinitro-o-cresol												
Pentachlorophenol					A							

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
3. acid fraction analyzed by GC/MS
4. concentration ranges:
   - A = 1 - 10 ug/L
   - B = 10 - 100 ug/L
   - C = 100 - 1000 ug/L (1000 ug/L = 1 mg/L)
   - D = 1 - 10 mg/L
   - E = 10 - 100 mg/L
   - F = 100 - 1000 mg/L
   - * = peak identified by GC but not confirmed by GC/MS analysis
   - - = peak identified by GC but not confirmed by GC/MS analysis of samples from related sites
5. + = compounds not separated by GC methodology

Table E3. Dow Canada Ltd., organic data 1980.

Compound	Service Water						3rd St. Sewer					
	E17 [2]	E18	E19	E37	E38	E39	E20 [1,2]	E21	E22 [2]	E40 [3]	E41	E42
Methylene chloride												
Trichlorofluoromethane				-				-	-	-		-
1,1-Dichloroethylene												
1,1-Dichloroethane		C				A	*	-			-	-
Trans-1,2-dichloroethylene												
Chloroform	A	A				A	*	-	-	-	-	-
1,2-Dichloroethane	B	B		A	A	B	B	B	B	A	A	B
1,1,1-Trichloroethane	A	A				A	A	A	A	A	A	A
Carbontetrachloride	A	B		A	A	A	C	B	B	C	C	C
Dichlorobromomethane +	A					B				-		
Bis(2-chloromethyl)ether +												
1,2-Dichloropropane												
Trans-1,3-dichloropropylene												
Trichloroethylene +												
Chlorodibromomethane +		A										
1,1,2-Trichloroethane +												
Cis-1,3-dichloropropene +												
Benzene +	A	B		A		B	A	A	A			A
2-Chloroethylvinylether +												
Bromoform	B			A	A	B	*	-	-	-	-	-
1,1,2,2-Tetrachloroethane +	B	B		A	A	A	A	A	A	A	A	A
Tetrachloroethylene +												
Toluene										A		
Chlorobenzene		A					*	-	-	-	-	-
Ethylbenzene												
1,3-Dichlorobenzene												
1,4-Dichlorobenzene										B	C	B
Hexachloroethane												
1,2-Dichlorobenzene												
Bis(2-chloroisopropyl)ether												
Nitrobenzene							A	B	B			
N-Nitroso-di-n-propylamine												
Bis(2-chloroethoxy)methane												
Hexachlorobutadiene												
1,2,4-Trichlorobenzene								A	A	B	A	A
Naphthalene									A	A	A	A
2-Chloronaphthalene				-	-						A	A
Acenaphthylene												
Acenaphthene												
Dimethyl phthalate										A	A	A
2,6-Dinitrotoluene	*				-							
Fluorene												A
4-Chlorophenyl phenyl ether +												
Diethyl phthalate +										A		
2,4-Dinitrotoluene +												
1,2-Diphenylhydrazine												
N-Nitrosodiphenylamine +												
Hexachlorobenzene +												
4-Bromophenyl phenyl ether +												
Phenanthrene +	*			-								
Anthracene +												
Di-n-butyl phthalate	*	-							A	A	A	A
Fluoranthene												
Pyrene												
Benzidine												
Butyl benzyl phthalate												
Bis(2-ethylhexyl)phthalate	A	A	A	A	A		A	A	B	A	A	A
Chrysene												
Benz(a)anthracene	*											
3,3-Dichlorobenzidine	*		-						*			-
Di-n-octyl phthalate												
Benzo(b)fluoranthene +												
Benzo(k)fluoranthene +												
Benzo(a)pyrene												
Indeno(1,2,3-c,d)pyrene +												
Dibenzo(a,h)anthracene +												
Benzo(g,h,i)perylene												
Phenol												
2-Chlorophenol												
2,4-Dimethylphenol +												
2-Nitrophenol +												
2,4-Dichlorophenol												
p-Chloro-m-cresol												
2,4,6-Trichlorophenol												
2,4-Dinitrophenol												
4-Nitrophenol												
4,6-Dinitro-o-cresol												
Pentachlorophenol							B	A	B	A	-	-

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
3. acid fraction analyzed by GC/MS
4. concentration ranges:
   - A = 1 - 10 ug/L
   - B = 10 - 100 ug/L
   - C = 100 - 1000 ug/L (1000 ug/L = 1 mg/L)
   - D = 1 - 10 mg/L
   - E = 10 - 100 mg/L
   - F = 100 - 1000 mg/L
   - * = peak identified by GC but not confirmed by GC/MS analysis
   - - = peak identified by GC but not confirmed by GC/MS analysis of samples from related sites
5. + = compounds not separated by GC methodology

Table E4. Ethyl Corporation, organic data 1980.

COMPOUND	Service Water						Final					
	2						1,2		2		3	
	E1	E2	E6	E29	E30	E33	E3	E4	E5	E31	E32	E34
Methylene chloride							D					
Trichlorofluoromethane	-			-						-	-	
1,1-Dichloroethylene	-			-							-	
1,1-Dichloroethane	-			-	A					-	-	
Trans-1,2-dichloroethylene												
Chloroform	A	A	A				*	-	-	-	-	-
1,2-Dichloroethane	A	A	A	B	A	B		-	-	-	-	-
1,1,1-Trichloroethane						A					A	
Carbontetrachloride		A	A	A	A	A	*	-	-	-	-	-
Dichlorobromomethane + Bis(2-chloromethyl)ether			-		-		*		-		-	
1,2-Dichloropropane	A	A				A	*	-	-	-	-	-
Trans-1,3-dichloropropylene												-
Trichloroethylene + Chlorodibromomethane + 1,1,2-Trichloroethane												
Cis-1,3-dichloropropene + Benzene + 2-Chloroethylvinylether				A		A		A			A	
Bromoform		A	A	A	A	A		-	-	-	-	-
1,1,2,2-Tetrachloroethane + Tetrachloroethylene				A					-			
Toluene												
Chlorobenzene										-	-	-
Ethylbenzene												
1,3-Dichlorobenzene												
1,4-Dichlorobenzene												
Hexachloroethane												
1,2-Dichlorobenzene												
Bis(2-chloroisopropyl)ether							*					
Nitrobenzene												
N-Nitroso-di-n-propylamine												
Bis(2-chloroethoxy)methane												
Hexachlorobutadiene												
1,2,4-Trichlorobenzene												
Naphthalene											-	-
2-Chloronaphthalene												
Acenaphthylene												
Acenaphthene												
Dimethyl phthalate												-
2,6-Dinitrotoluene												-
Fluorene + 4-Chlorophenyl phenyl ether												
Diethyl phthalate + 2,4-Dinitrotoluene												
1,2-Diphenylhydrazine												-
N-Nitrosodiphenylamine + Hexachlorobenzene												-
4-Bromophenyl phenyl ether												
Phenanthrene + Anthracene									*		-	
Di-n-butyl phthalate								-		-	-	-
Fluoranthene										-		
Pyrene										-		
Benzidine												
Butyl benzyl phthalate											-	-
Bis(2-ethylhexyl)phthalate										-	-	-
Chrysene												
Benz(a)anthracene												
3,3-Dichlorobenzidine												
Di-n-octyl phthalate										-	-	-
Benzo(b)fluoranthene + Benzo(k)fluoranthene											-	-
Benzo(a)pyrene												
Indeno(1,2,3-c,d)pyrene + Dibenzo(a,h)anthracene												
Benzo(g,h,i)perylene												
Phenol												
2-Chlorophenol												
2,4-Dimethylphenol												
2-Nitrophenol												
2,4-Dichlorophenol												
p-Chloro-m-cresol												
2,4,6-Trichlorophenol												
2,4-Dinitrophenol												
4-Nitrophenol												
4,6-Dinitro-o-cresol										-		
Pentachlorophenol										B	A	A

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
3. acid fraction analyzed by GC/MS
4. concentration ranges:
   - A = 1 - 10 ug/L
   - B = 10 - 100 ug/L
   - C = 100 - 1000 ug/L (1000 ug/L = 1 mg/L)
   - D = 1 - 10 mg/L
   - E = 10 - 100 mg/L
   - F = 100 - 1000 mg/L
   - * = peak identified by GC but not confirmed by GC/MS analysis
   - - = peak identified by GC but not confirmed by GC/MS analysis of samples from related sites
5. + = compounds not separated by GC methodology

Table E5. Petrosar Limited, Chemical DAF, organic data 1980.

Compound	Chemical DAF 1,2 E49	2,3 E55	2 E60	2 E64	2 E70	2 E74	2 E79	2 E83	2 E88
Methylene chloride	B		C	B	B		B	B	B
Trichlorofluoromethane									
1,1-Dichloroethylene	*					-		-	-
1,1-Dichloroethane									
Trans-1,2-dichloroethylene								A	
Chloroform	A	A	B		A	A	A		
1,2-Dichloroethane	A	A	B		A	A	A	A	
1,1,1-Trichloroethane	A				A		B	A	A
Carbontetrachloride		-							
Dichlorobromomethane +							-	-	-
Bis(2-chloromethyl)ether +									
1,2-Dichloropropane			-			-	-	-	-
Trans-1,3-dichloropropylene									
Trichloroethylene +									
Chlorodibromomethane +	A							A	A
1,1,2-Trichloroethane +									
Cis-1,3-dichloropropene +									
Benzene +	E	E	E	D	E	E	E	E	E
2-Chloroethylvinylether +									
Bromoform	*	-	-	-	-	-	-	-	-
1,1,2,2-Tetrachloroethane +	A	A	B	B		A	A	A	A
Tetrachloroethylene +									
Toluene	D	D	C	B	D	D	D	D	D
Chlorobenzene	*	-	-	-	-	-	-	-	-
Ethylbenzene	C	C	C	C	C	C	D	C	C
1,3-Dichlorobenzene	B		*	*		*		-	
1,4-Dichlorobenzene	*								
Hexachloroethane	*								
1,2-Dichlorobenzene									
Bis(2-chloroisopropyl)ether	*			*					
Nitrobenzene	*	*	*		*	*		A	*
N-Nitroso-di-n-propylamine			*						
Bis(2-chloroethoxy)methane									
Hexachlorobutadiene	*		*		*	*			
1,2,4-Trichlorobenzene	*	*	*	*	*	*	*		
Naphthalene	B		*	A	B	B		B	B
2-Chloronaphthalene	*	*	*	*	*	*	*		*
Acenaphthylene	A	*		*	A	*	A	B	*
Acenaphthene	B	*	*	A	B	*	D	*	*
Dimethyl phthalate	*	*	*	*	*	*	*		*
2,6-Dinitrotoluene	*	*	*	*	*	*	*		*
Fluorene +	*	*	B	B	B	C	B	B	C
4-Chlorophenyl phenyl ether +									
Diethyl phthalate +	A	*	*	*	*	*	*		*
2,4-Dinitrotoluene +			*						*
1,2-Diphenylhydrazine		*	*	*	*	*			
N-Nitrosodiphenylamine +									
Hexachlorobenzene +	*	*	*		B	*	B		*
4-Bromophenyl phenyl ether +									
Phenanthrene +	A	A	B	B	C	C	A	B	
Anthracene +									
Di-n-butyl phthalate	*	*	*		C	*	A	B	*
Fluoranthene	*	*	*	B	B	B	A	A	*
Pyrene	*	*	*	B	B	B		B	*
Benzidine	*	*	*		*	*	*		*
Butyl benzyl phthalate	*		*		*	*	*		*
Bis(2-ethylhexyl)phthalate		*	*	C	C	B	A	B	
Chrysene	*	*	*						
Benz(a)anthracene	*	*	*	A		B			*
3,3-Dichlorobenzidine	*	*							*
Di-n-octyl phthalate					A				
Benzo(b)fluoranthene +				*					
Benzo(k)fluoranthene +									
Benzo(a)pyrene									
Indeno(1,2,3-c,d)pyrene +									
Dibenzo(a,h)anthracene +									
Benzo(g,h,i)perylene				*					
Phenol	B	B	D	D	D	C	D	D	D
2-Chlorophenol									
2,4-Dimethylphenol	B	C	C	D	D	D	E	E	E
2-Nitrophenol		-	-	-	-	-	-	-	-
2,4-Dichlorophenol		-	-	-					
p-Chloro-m-cresol			-	-	-	-	-	-	-
2,4,6-Trichlorophenol	-	-	-	-	-	-	-	-	-
2,4-Dinitrophenol									
4-Nitrophenol	-	-							
4,6-Dinitro-o-cresol									
Pentachlorophenol	-	-	-	-	-			-	-

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
3. acid fraction analyzed by GC/MS
4. concentration ranges:
   - A = 1 - 10 ug/L
   - B = 10 - 100 ug/L
   - C = 100 - 1000 ug/L (1000 ug/L = 1 mg/L)
   - D = 1 - 10 mg/L
   - E = 10 - 100 mg/L
   - F = 100 - 1000 mg/L
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   - - = peak identified by GC but not confirmed by GC/MS analysis of samples from related sites
5. + = compounds not separated by GC methodology

Table E6. Petrosar Limited, Oily DAF, organic data 1980.

Compound	Oily DAF 1,2 E50	2 E56	2 E61	2 E65	2 E71	2 E75	2 E80	2 E84	2 E89
Methylene chloride	B	B	B	B					
Trichlorofluoromethane									
1,1-Dichloroethylene	*				-			-	
1,1-Dichloroethane									
Trans-1,2-dichloroethylene									
Chloroform	A	A	A	A					
1,2-Dichloroethane	A	A	A	A					
1,1,1-Trichloroethane	A	A		A					
Carbontetrachloride									
Dichlorobromomethane +	*	-							
Bis(2-chloromethyl)ether +									
1,2-Dichloropropane				-					-
Trans-1,3-dichloropropylene									
Trichloroethylene +									
Chlorodibromomethane +	A	A		A					
1,1,2-Trichloroethane +									
Cis-1,3-dichloropropene +									
Benzene +	F	E	E	E	E	D	F	E	E
2-Chloroethylvinylether +									
Bromoform	*	-	-	-	-		-	-	-
1,1,2,2-Tetrachloroethane +	A	A		A					
Tetrachloroethylene +									
Toluene	D	D	D	D	D	D	E	D	D
Chlorobenzene		-	-	-	-	-		-	-
Ethylbenzene	C	C	C	B	C	C	D	C	D
1,3-Dichlorobenzene	*		*	*		*			
1,4-Dichlorobenzene									
Hexachloroethane									
1,2-Dichlorobenzene									
Bis(2-chloroisopropyl)ether	*								*
Nitrobenzene	*	*		*	*				*
N-Nitroso-di-n-propylamine		*							
Bis(2-chloroethoxy)methane									
Hexachlorobutadiene				*	*	*			
1,2,4-Trichlorobenzene	*	*	*	*	*	*			
Naphthalene	B					A	A	B	B
2-Chloronaphthalene	*	*	*	*	*	*	*		*
Acenaphthylene	A	*	B	A	B	A	A	B	B
Acenaphthene	B	*	*	B	B	B	B	B	C
Dimethyl phthalate	*	*	*	*	*	*	*		*
2,6-Dinitrotoluene	*	*	*	*		*	*		
Fluorene +	*	A	B	B	B	B	A	B	C
4-Chlorophenyl phenyl ether +									
Diethyl phthalate +	B	*	*				*	B	
2,4-Dinitrotoluene +		*							*
1,2-Diphenylhydrazine	*	*	*	*	B	*	*		*
N-Nitrosodiphenylamine +									
Hexachlorobenzene +	*		*	A	*	*	*		*
4-Bromophenyl phenyl ether +									
Phenanthrene +	A	B	B	B	B	B	A		C
Anthracene +									
Di-n-butyl phthalate	*	*	*	A	A	B	B	C	*
Fluoranthene	*	*	*	B	B	B	A	A	*
Pyrene	*	*	*	B	A	B	A		*
Benzidine	*	*				*			
Butyl benzyl phthalate		*					*		*
Bis(2-ethylhexyl)phthalate		*	*	*	B	B	A	C	B
Chrysene	*	*	*	A		*	*		*
Benz(a)anthracene		*		*		*			*
3,3-Dichlorobenzidine	*	*		*		*			*
Di-n-octyl phthalate							*		
Benzo(b)fluoranthene +		*							
Benzo(k)fluoranthene +									
Benzo(a)pyrene					*		*		
Indeno(1,2,3-c,d)pyrene +			*	*		*			
Dibenzo(a,h)anthracene +									
Benzo(g,h,i)perylene									
Phenol						C	D		C
2-Chlorophenol									
2,4-Dimethylphenol +	C	D	C	-	C	D	D	C	D
2-Nitrophenol +					-				
2,4-Dichlorophenol									
p-Chloro-m-cresol			-	-	-	-	-	-	-
2,4,6-Trichlorophenol		-	-		-	-		-	-
2,4-Dinitrophenol									
4-Nitrophenol	-						-	-	-
4,6-Dinitro-o-cresol									
Pentachlorophenol					-				

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
3. acid fraction analyzed by GC/MS
4. concentration ranges:
   - A = 1 - 10 ug/L
   - B = 10 - 100 ug/L
   - C = 100 - 1000 ug/L (1000 ug/L = 1 mg/L)
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   - F = 100 - 1000 mg/L
   - * = peak identified by GC but not confirmed by GC/MS analysis
   - - = peak identified by GC but not confirmed by GC/MS analysis of samples from related sites
5. + = compounds not separated by GC methodology

Table E7. Petrosar Limited, Bio-oxidation Unit, organic data 1980.

Compound	Bio-oxidation Unit								
	1,2 E51	3 E57	E62	E66	E72	E76	E81	E85	E90
Methylene chloride	B	B	B			B	B	B	
Trichlorofluoromethane									
1,1-Dichloroethylene			A				A	A	
1,1-Dichloroethane									
Trans-1,2-dichloroethylene									
Chloroform	A					A	A	A	
1,2-Dichloroethane	B	A	A	A	A	A	A	A	
1,1,1-Trichloroethane	A			A		A	A	A	
Carbontetrachloride									
Dichlorobromomethane +									-
Bis(2-chloromethyl)ether +									
1,2-Dichloropropane									
Trans-1,3-dichloropropylene									
Trichloroethylene									
Chlorodibromomethane +	A	A		A		A	A	A	
1,1,2-Trichloroethane									
Cis-1,3-dichloropropene									
Benzene +	B	B	C	C	B	B	C	C	D
2-Chloroethylvinylether									
Bromoform	*	-	-	-	-	-	-	-	-
1,1,2,2-Tetrachloroethane +	A	A	A	A		A	A	A	
Tetrachloroethylene									
Toluene	A	A	C	C	B	A	C	C	C
Chlorobenzene			-	-	-	-	-	-	-
Ethylbenzene	A	B	B	C		A	C	C	B
1,3-Dichlorobenzene	A		-						
1,4-Dichlorobenzene									
Hexachloroethane									
1,2-Dichlorobenzene									
Bis(2-chloroisopropyl)ether	*								
Nitrobenzene	*	-	-		-				
N-Nitroso-di-n-propylamine		-	-						
Bis(2-chloroethoxy)methane									
Hexachlorobutadiene			-		-				
1,2,4-Trichlorobenzene	*			-	-			-	
Naphthalene	B		-	A	B			A	A
2-Chloronaphthalene	*	-	-	-	-	-	-	-	
Acenaphthylene	A	-	B	B	B	A	B	B	C
Acenaphthene	B	-	-	B	C	B	C	C	C
Dimethyl phthalate	*	-	-	-	-	-	-	-	-
2,6-Dinitrotoluene		-	-	-	-	-	-	-	-
Fluorene +		A	B	B	C	A	B	B	C
4-Chlorophenyl phenyl ether +					-				
Diethyl phthalate +		-	-					B	
2,4-Dinitrotoluene			-				-		-
1,2-Diphenylhydrazine			-	-	B		-	-	-
N-Nitrosodiphenylamine									
Hexachlorobenzene +		-	-	-	C	-		-	-
4-Bromophenyl phenyl ether									
Phenanthrene +	A	A	B	C	C	B	B	C	C
Anthracene									
Di-n-butyl phthalate	*	-	-	B	C	B	B	B	-
Fluoranthene		-	-	B	B	A		B	-
Pyrene		-	-	B	B	B		B	-
Benzidine		-	-	-				-	-
Butyl benzyl phthalate				A	-			-	
Bis(2-ethylhexyl)phthalate	A	-	-	B	C	C	A	C	C
Chrysene				B	C	-		-	-
Benz(a)anthracene			-		C	A		-	-
3,3-Dichlorobenzidine		-				-		-	-
Di-n-octyl phthalate				B	A	-			
Benzo(b)fluoranthene +				-	C			-	
Benzo(k)fluoranthene									
Benzo(a)pyrene					-				
Indeno(1,2,3-c,d)pyrene +			-	-		-			
Dibenzo(a,h)anthracene									
Benzo(g,h,i)perylene				-					
Phenol							D		
2-Chlorophenol									
2,4-Dimethylphenol +	C	*	C	D	D	D	E	D	D
2-Nitrophenol		*				-			
2,4-Dichlorophenol	-								
p-Chloro-m-cresol			-	-	-	-	-	-	-
2,4,6-Trichlorophenol	-		-	-	-	-	-	-	
2,4-Dinitrophenol									
4-Nitrophenol	-	*	-	-					
4,6-Dinitro-o-cresol									
Pentachlorophenol	-		-		-		-		-

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
3. acid fraction analyzed by GC/MS
4. concentration ranges:
   - A = 1 - 10 ug/L
   - B = 10 - 100 ug/L
   - C = 100 - 1000 ug/L (1000 ug/L = 1 mg/L)
   - D = 1 - 10 mg/L
   - E = 10 - 100 mg/L
   - F = 100 - 1000 mg/L
   - * = peak identified by GC but not confirmed by GC/MS analysis
   - - = peak identified by GC but not confirmed by GC/MS analysis of samples from related sites
5. + = compounds not separated by GC methodology

Table E8. Petrosar Limited, A/C filter, organic data 1980.

Compound	A/C Filter 1,2 E52	3 E58	E63	E67	E73	E77	E82	E86	E91
Methylene chloride	B								
Trichlorofluoromethane									
1,1-Dichloroethylene	A				A				
1,1-Dichloroethane									
Trans-1,2-dichloroethylene									
Chloroform	A	A			A				
1,2-Dichloroethane	A	A			A				A
1,1,1-Trichloroethane	A								
Carbontetrachloride									
Dichlorobromomethane +									-
Bis(2-chloromethyl)ether +									
1,2-Dichloropropane									
Trans-1,3-dichloropropylene									
Trichloroethylene +									
Chlorodibromomethane +									
1,1,2-Trichloroethane +									
Cis-1,3-dichloropropene +									
Benzene +	D	E		A	E	E	E	D	E
2-Chloroethylvinylether +									
Bromoform					-				-
1,1,2,2-Tetrachloroethane +								A	
Tetrachloroethylene +									
Toluene	A	C				B		A	C
Chlorobenzene									
Ethylbenzene		B				B		B	B
1,3-Dichlorobenzene									
1,4-Dichlorobenzene									
Hexachloroethane									
1,2-Dichlorobenzene									
Bis(2-chloroisopropyl)ether									
Nitrobenzene	*	-			-				
N-Nitroso-di-n-propylamine									
Bis(2-chloroethoxy)methane									
Hexachlorobutadiene	*				-				
1,2,4-Trichlorobenzene								-	
Naphthalene								A	
2-Chloronaphthalene							-	-	
Acenaphthylene									
Acenaphthene									
Dimethyl phthalate	*						-	-	-
2,6-Dinitrotoluene								-	
Fluorene +			-						
4-Chlorophenyl phenyl ether +					-				
Diethyl phthalate +									
2,4-Dinitrotoluene +								-	
1,2-Diphenylhydrazine									
N-Nitrosodiphenylamine +									
Hexachlorobenzene +									
4-Bromophenyl phenyl ether +									
Phenanthrene +									
Anthracene +									
Di-n-butyl phthalate	*						A	A	-
Fluoranthene									-
Pyrene							A		
Benzidine	*		-		-	-	-	-	-
Butyl benzyl phthalate									
Bis(2-ethylhexyl)phthalate	A		-					A	A
Chrysene									
Benz(a)anthracene									
3,3-Dichlorobenzidine			-		-		-	-	
Di-n-octyl phthalate									
Benzo(b)fluoranthene +									
Benzo(k)fluoranthene +									
Benzo(a)pyrene							-		
Indeno(1,2,3-c,d)pyrene +									-
Dibenzo(a,h)anthracene +									
Benzo(g,h,i)perylene									
Phenol	B				D	C	C	C	B
2-Chlorophenol									
2,4-Dimethylphenol +		D		C	D	C			A
2-Nitrophenol +									
2,4-Dichlorophenol									
p-Chloro-m-cresol			-	-	-	-	-	-	-
2,4,6-Trichlorophenol	-								-
2,4-Dinitrophenol									
4-Nitrophenol		*							
4,6-Dinitro-o-cresol									
Pentachlorophenol									

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
3. acid fraction analyzed by GC/MS
4. concentration ranges:
   - A = 1 - 10 ug/L
   - B = 10 - 100 ug/L
   - C = 100 - 1000 ug/L (1000 ug/L = 1 mg/L)
   - D = 1 - 10 mg/L
   - E = 10 - 100 mg/L
   - F = 100 - 1000 mg/L
   - * = peak identified by GC but not confirmed by GC/MS analysis
   - - = peak identified by GC but not confirmed by GC/MS analysis of samples from related sites
5. + = compounds not separated by GC methodology

Table E9. Petrosar Limited, service water and final discharge organic data 1980.

Compound	Service Water			Final				
		3		1,2			3	
	E54	E69	E87	E53	E59	E68	E78	E92
Methylene chloride								
Trichlorofluoromethane								
1,1-Dichloroethylene				A				
1,1-Dichloroethane								
Trans-1,2-dichloroethylene								
Chloroform	A	A	A	A	A	A	A	A
1,2-Dichloroethane	B	A	B	B	A	B	A	A
1,1,1-Trichloroethane				A				
Carbontetrachloride	B	A	A					
Dichlorobromomethane +		A	B	*				
Bis(2-chloromethyl)ether +								
1,2-Dichloropropane	A	A	A	*			-	-
Trans-1,3-dichloropropylene								
Trichloroethylene +								
Chlorodibromomethane +								
1,1,2-Trichloroethane +								
Cis-1,3-dichloropropene +								
Benzene +	A	A	A	A	B	D	B	C
2-Chloroethylvinylether +								
Bromoform	A	A	A		-		-	-
1,1,2,2-Tetrachloroethane +	A		A					
Tetrachloroethylene +								
Toluene		A				A		A
Chlorobenzene						-	-	-
Ethylbenzene						B		A
1,3-Dichlorobenzene						-		
1,4-Dichlorobenzene								
Hexachloroethane								
1,2-Dichlorobenzene								
Bis(2-chloroisopropyl)ether	-					-		
Nitrobenzene				*	-	-		
N-Nitroso-di-n-propylamine						-	-	
Bis(2-chloroethoxy)methane								
Hexachlorobutadiene				*			-	
1,2,4-Trichlorobenzene						-		
Naphthalene						A		A
2-Chloronaphthalene				*	-	-	-	
Acenaphthylene				A	-	A		A
Acenaphthene				A	-	B		B
Dimethyl phthalate				*	-	-		-
2,6-Dinitrotoluene				*	-	-	-	-
Fluorene +					A	A	A	B
4-Chlorophenyl phenyl ether +				*				
Diethyl phthalate +				A	-	-	-	-
2,4-Dinitrotoluene +					-	B	-	
1,2-Diphenylhydrazine				*	-	-	-	
N-Nitrosodiphenylamine +								
Hexachlorobenzene +				*	-	-	-	-
4-Bromophenyl phenyl ether +								
Phenanthrene +				A	A	A	A	A
Anthracene +								
Di-n-butyl phthalate		A		*	-	B	A	-
Fluoranthene				*	-	A	A	-
Pyrene				*	-	A		-
Benzidine			-		-	-		-
Butyl benzyl phthalate						A		
Bis(2-ethylhexyl)phthalate		A	A				A	A
Chrysene						A		
Benz(a)anthracene						A		-
3,3-Dichlorobenzidine			-					
Di-n-octyl phthalate								
Benzo(b)fluoranthene +								
Benzo(k)fluoranthene +								
Benzo(a)pyrene								
Indeno(1,2,3-c,d)pyrene +						-		
Dibenzo(a,h)anthracene +								
Benzo(g,h,i)perylene								
Phenol								
2-Chlorophenol								
2,4-Dimethylphenol +						D	A	B
2-Nitrophenol +						-	*	-
2,4-Dichlorophenol								
p-Chloro-m-cresol						-	*	
2,4,6-Trichlorophenol						-	*	
2,4-Dinitrophenol								
4-Nitrophenol								-
4,6-Dinitro-o-cresol								
Pentachlorophenol						-	*	-

1. volatile fraction analyzed by GC/MS
2. base/neutral fraction analyzed by GC/MS
3. acid fraction analyzed by GC/MS
4. concentration ranges:
   - A = 1 - 10 ug/L
   - B = 10 - 100 ug/L
   - C = 100 - 1000 ug/L (1000 ug/L = 1 mg/L)
   - D = 1 - 10 mg/L
   - E = 10 - 100 mg/L
   - F = 100 - 1000 mg/L
   - * = peak identified by GC but not confirmed by GC/MS analysis
   - - = peak identified by GC but not confirmed by GC/MS analysis of samples from related sites
5. + = compounds not separated by GC methodology

APPENDIX F

1980 DISCHARGE FLOW RATES

TABLE F1: Polysar Daily Flows (10^6 L/day) during sampling period August 12-31, 1980.

Date	Ditch In	Ditch Out
August 12	34	195
" 13	32	183
" 14	34	193
" 15	33	193
" 16	32	185
" 17	32	200
" 18	32	188
" 19	29	193
" 20	34	183
" 21	32	188
" 22	35	201
" 23	32	183
" 24	31	186
" 25	29	185
" 26	35	203
" 27	32	200
" 28	31	188
" 29	34	195
" 30	34	234
" 31	29	200

TABLE F2: Petrosar Effluent Flow (USGPM) at the Waste Treatment Sample Sites, September 5-15, 1980.

Date	Site Numbers[1]						
	1	2	3	4	5	6	7
September 5	250	500	150	300	350	1000	100
" 6	175	525	150	225	375	2400	100
" 7	200	525	150	250	375	2400	100
" 8	200	575	200	250	375	2200	150
" 9	200	575	200	250	375	1700	150
" 10	150	580	200	200	380	1200	150
" 11	200	600	200	300	400	2200	100
" 12	200	600	225	325	375	2700	100
" 13	175	620	200	275	420	2800	100
" 14	200	625	200	300	425	2700	100
" 15	300	990	200	400	575	1700	100

[1]Sites identified on treatment plant flow diagram, Figure B:9.

APPENDIX G

1980 CONVENTIONAL CHEMICAL DATA

Table G1. Esso Chemical Intake , 1980.

Date	Sample Number	Solids (mg/L)			Carbon (mg/L)			Phenols (ug/L)
		Total	Sus.	Dis.	DOC	DIC	PTC	
July 29-Aug. 2	E7	121	6	115	2.0	19.4	0.5	<1
Aug. 3-7	E8	128	8	120	2.2	19.6	0.7	<1
Aug. 8-12	E11	120	<5	115	2.0	20.2	0.2	1
Aug. 13-17	E12	115	<5	110	2.1	20.4	0.9	<1
Aug. 18-22	E13	130	7	123	2.1	20.4	0.9	<1
Aug. 23-27	E35	120	<5	115	1.5	19.4	0.5	1

Table G2. Esso Chemical Final, 1980.

Date	Sample Number	Solids (mg/L)			Carbon (mg/L)			Phenols (ug/L)
		Total	Sus.	Dis.	DOC	DIC	PTC	
July 29-Aug. 2	E9	230	30	200	5.8	23.2	2.9	21
Aug. 3-7	E10	220	20	200	7.8	22.6	4.1	35
Aug. 8-12	E14	185	14	171	11.0	24.4	3.9	15
Aug. 13-17	E15	160	<5	155	3.8	22.6	1.2	9
Aug. 18-22	E16	160	<5	165	3.0	19.2	1.0	7

Table G3. Esso Chemical Final , 1980.

Date	Solids (mg/L)			Carbon (mg/L)			Phenols (ug/L)
	Total	Sus.	Dis	DOC	DIC	PTC	
July 29	260	19	241	8.7	23.0	-	29
July 30	-	-	-	-	-	-	35
July 31	-	13	-	4.0	19.4	1.8	62
Aug. 1	-	20	-	4.7	22.4	2.2	33
Aug. 2	-	8	-	4.6	23.0	2.1	26
Aug. 3	-	1	-	4.5	22.2	1.5	28
Aug. 4	-	7	-	4.9	22.0	2.4	19
Aug. 5	-	<5	-	4.3	22.2	1.2	21
Aug. 6	-	4	-	14.4	23.0	5.5	90
Aug. 7	-	25	-	10.7	22.6	2.7	70
Aug. 8	-	20	-	8.3	22.0	4.2	-
Aug. 9	-	14	-	7.3	22.0	2.0	-
Aug. 10	-	35	-	8.7	22.2	6.7	-
Aug. 11	-	<5	-	31.0	21.2	2.7	-
Aug. 12	-	15	-	7.5	21.2	2.1	30
Aug. 13	-	<5	-	4.5	21.0	1.2	15
Aug. 14	-	<5	-	4.6	21.4	1.3	15
Aug. 15	-	-	-	4.5	23.2	0.3	20
Aug. 16	170	<5	170	3.6	22.6	1.3	20
Aug. 17	-	6	-	3.0	23.6	1.0	13
Aug. 18	155	10	145	3.0	21.6	1.3	20
Aug. 19	220	9	211	2.5	3.2	1.5	17
Aug. 20	150	8	142	2.6	21.6	1.1	13
Aug. 21	150	7	143	2.9	22.0	1.2	22
Aug. 22	150	<5	145	3.3	22.2	1.0	22
Aug. 23	205	9	196	2.9	23.2	1.5	7
Aug. 24	210	14	196	3.0	24.0	1.9	8
Aug. 25	215	<5	210	2.8	24.0	1.6	9
Aug. 26	220	<5	215	2.8	23.2	1.1	10
Aug. 27	150	6	144	3.0	23.2	0.9	12

Table G4. Polysar Intake , 1980.

Date	Solids (mg/L)			Carbon (mg/L)			Phenols (ug/L)
	Total	Sus.	Dis	DOC	DIC	PTC	
Aug. 12-16	135	<5	130	2.0	19.8	0.3	<1
Aug. 17-21	125	<5	120	2.1	20.2	0.5	<1
Aug. 22-26	140	<5	135	1.6	20.0	0.5	2
Aug. 27-31	145	5	140	2.1	20.0	0.5	2

Table G5. Polysar Ditch In , 1980.

Date	Solids (mg/L)			Carbon (mg/L)			Phenols (ug/L)
	Total	Sus.	Dis	DOC	DIC	PTC	
Aug. 12-16	255	5	250	3.3	25.6	0.7	3
Aug. 17-21	225	<5	220	3.8	24.6	0.7	2
Aug. 22-26	315	6	309	4.6	29.8	0.7	2
Aug. 27-31	230	5	225	6.9	22.4	1.5	2

Table G6. Polysar Ditch In , 1980.

Date	Solids (mg/L)			Carbon (mg/L)			Phenols (ug/L)
	Total	Sus.	Dis	DOC	DIC	PTC	
July 30	251	4	247	3.3	25.4	-	5
July 31	-	14	-	7.8	24.6	2.2	15
Aug. 1	-	2	-	3.5	23.0	-	5
Aug. 2	-	3	-	2.5	21.2	-	4
Aug. 3	-	7	-	4.5	24.4	0.6	43
Aug. 4	-	5	-	4.4	22.6	<.5	6
Aug. 5	-	<5	-	3.4	21.0	0.5	4
Aug. 6	-	35	-	5.7	26.6	1.9	11
Aug. 7	-	5	-	3.6	24.8	0.5	21
Aug. 8	-	5	-	3.2	22.4	2.1	-
Aug. 9	-	<5	-	3.4	23.4	0.5	10
Aug. 10	-	<5	-	2.8	23.4	0.4	5
Aug. 11	-	-	-	3.6	24.0	0.3	3
Aug. 12	-	<5	-	4.3	27.8	0.3	5
Aug. 13	-	<5	-	3.3	23.8	0.3	6
Aug. 14	-	<5	-	5.1	24.8	0.4	6
Aug. 15	-	<5	-	4.8	26.4	0.8	60
Aug. 16	205	<5	200	3.4	23.6	0.4	12
Aug. 17	230	5	225	8.0	23.0	0.7	31
Aug. 18	225	<5	220	3.8	25.8	0.7	10
Aug. 19	240	<5	235	4.2	24.8	0.5	11
Aug. 20	185	<5	180	2.5	4.0	0.8	9
Aug. 21	215	<5	210	3.6	24.0	0.9	5
Aug. 22	240	<5	235	?4.3	24.4	0.5	14
Aug. 23	235	<5	230	2.9	23.2	0.4	3
Aug. 24	235	<5	230	3.0	23.0	<.4	3
Aug. 25	200	<5	195	3.3	24.0	0.5	8
Aug. 26	725	<5	720	13.0	52.0	0.9	3
Aug. 27	220	<5	215	3.4	24.6	0.5	7
Aug. 28	195	10	185	2.8	22.4	5.6	4
Aug. 29	185	<5	180	2.9	21.6	-	2
Aug. 30	185	<5	180	12.8	22.4	0.5	44
Aug. 31	300	<5	295	15.4	24.2	-	75

Table G7. Polysar Ditch Out , 1980.

Date	Solids (mg/L)			Carbon (mg/L)			Phenols (ug/L)
	Total	Sus.	Dis	DOC	DIC	PTC	
Aug. 12-16	160	5	155	1.9	20.8	1.1	2
Aug. 17-21	150	6	144	2.3	20.8	0.8	2
Aug. 22-26	145	<5	140	2.6	21.2	-	3
Aug. 27-31	165	<5	160	3.2	21.4	-	1

Table G8. Polysar Ditch Out , 1980.

Date	Solids (mg/L)			Carbon (mg/L)			Phenols (ug/L)
	Total	Sus.	Dis	DOC	DIC	PTC	
July 30	183	4	179	2.6	21.8	-	2
July 31	-	5	-	3.1	20.2	1.4	2
Aug. 1	-	5	-	2.8	20.2	0.7	3
Aug. 2	-	15	-	2.8	19.8	0.7	3
Aug. 3	-	9	-	3.4	19.8	1.2	25
Aug. 4	-	2	-	3.5	20.2	-	4
Aug. 5	-	4	-	3.2	20.0	1.0	2
Aug. 6	-	180	-	3.9	20.8	14.0	10
Aug. 7	-	10	-	3.1	20.6	2.8	4
Aug. 8	-	4	-	8.7	20.8	1.0	-
Aug. 9	-	13	-	7.4	20.0	0.9	7
Aug. 10	-	<5	-	2.6	19.6	0.7	2
Aug. 11	-	-	-	2.6	19.4	0.4	3
Aug. 12	-	<5	-	3.2	21.2	1.2	4
Aug. 13	-	<5	-	2.8	19.2	0.4	<1
Aug. 14	-	<5	-	3.7	19.8	0.6	<1
Aug. 15	-	-	-	3.1	19.6	<.2	24
Aug. 16	155	5	150	3.5	19.2	0.6	8
Aug. 17	145	6	139	3.7	22.2	0.8	13
Aug. 18	145	5	140	4.8	20.0	0.8	12
Aug. 19	150	<5	145	3.4	20.0	0.7	8
Aug. 20	155	5	150	2.6	20.0	0.6	7
Aug. 21	150	<5	-	4.3	20.0	1.1	20
Aug. 22	150	<5	-	3.7	20.6	1.0	10
Aug. 23	200	<5	195	3.5	21.8	0.6	3
Aug. 24	140	<5	135	3.8	21.6	6.7	2
Aug. 25	145	<5	140	3.6	21.6	-	-
Aug. 26	190	<5	-	4.2	21.8	0.6	-
Aug. 27	180	<5	175	3.4	21.8	0.8	-
Aug. 28	180	<5	175	3.1	19.6	0.6	2
Aug. 29	180	<5	175	3.1	19.6	0.6	2
Aug. 30	185	<5	180	3.5	20.4	0.6	3
Aug. 31	180	<5	175	10.7	22.4	2.0	3

Table G9. Dow Intake , 1980.

Date	Sample Number	Solids (mg/L)			Carbon (mg/L)			Phenols (ug/L)
		Total	Sus.	Dis.	DOC	DIC	PTC	
Aug. 6-10	E17	130	<5	125	2.2	20.0	0.4	<1
Aug.11-15	E18	130	<5	125	2.2	20.2	0.4	<1
Aug. 16-20	E19	125	<5	120	2.2	20.2	0.5	1
Aug. 21-25	E37	130	<5	125	1.3	19.4	0.5	2
Aug. 26-30	E38	135	5	130	1.5	19.6	0.5	4
Aug. 31-Sept.4	E39	140	5	135	1.8	19.2	0.5	5

Table G10. Dow 3rd St. Sewer, 1980.

Date	Sample Number	Solids (mg/L)			Carbon (mg/L)			Phenols (ug/L)
		Total	Sus.	Dis.	DOC	DIC	PTC	
Aug. 6-10	E20	190	<5	185	4.9	19.8	0.8	45
Aug. 11-15	E21	190	<5	185	6.4	19.2	0.8	36
Aug. 16-20	E22	180	<5	175	6.2	19.6	1.6	130
Aug. 21-25	E40	130	<5	125	26.5	19.4	-	13
Aug. 26-30	E41	125	<5	120	8.9	19.4	-	32
Aug. 31-Sept. 4	E42	155	5	150	9.0	21.2	-	38

Table G11. Dow 3rd Street Sewer , 1980.

Date	Solids (mg/L)			Carbon (mg/L)			Phenols (ug/L)
	Total	Sus.	Dis	DOC	DIC	PTC	
Aug. 6	-	6	-	4.9	18.8	1.2	100
Aug. 7	-	5	-	4.9	19.6	1.1	110
Aug. 8	-	11	-	5.2	17.6	1.1	110
Aug. 10	-	<5	-	7.2	17.8	0.6	75
Aug. 11	-	<5	-	6.0	18.2	0.8	65
Aug. 12	-	<5	-	6.5	18.4	0.5	75
Aug. 13	-	<5	-	7.0	17.6	0.6	175
Aug. 14	-	<5	-	7.9	18.0	0.7	75
Aug. 15	-	<5	-	8.5	18.4	0.4	3
Aug. 16	200	7	193	7.4	16.6	1.8	90
Aug. 17	190	<5	185	6.6	19.0	1.0	150
Aug. 18	175	5	170	6.2	21.2	2.5	130
Aug. 19	195	7	188	7.0	20.0	3.8	230
Aug. 20	185	5	180	6.6	19.6	1.1	1000
Aug. 21	170	11	159	6.7	19.2	1.2	650
Aug .22	160	<5	155	65.0	19.4	1.0	210
Aug. 23	190	<5	185	10.0	20.4	0.6	-
Aug. 24	225	7	218	70.0	19.6	1.7	60
Aug. 25	150	<5	145	8.6	18.8	0.6	105
Aug. 26	175	<5	170	5.4	20.0	0.7	65
Aug. 27	-	<5	-	14.0	20.0	0.9	125
Aug. 28	-	5	-	16.4	20.4	0.8	80
Aug. 29	160	<5	155	9.3	18.8	0.9	60
Aug. 30	140	<5	135	6.2	19.8	<5.0	65
Aug. 31	155	<5	150	12.0	19.4	0.9	50
Sept. 1	180	<5	175	8.6	20.0	0.6	35
Sept. 2	160	<5	155	9.7	19.6	0.6	55
Sept. 3	170	23	147	5.2	20.4	6.0	31
Sept. 4	170	<5	165	12.2	19.0	0.8	425
Sept. 5	160	<5	155	11.9	18.0	1.1	200

Table G12. Ethyl Corporation Service Water , 1980

Date	Sample Number	Solids (mg/L)			Carbon (mg/L)			Phenols (ug/L)
		Total	Sus.	Dis.	DOC	DIC	PTC	
July 16-22	E1	275	10	265	2.6	19.4	.8	<1
July 23-29	E2	250	5	245	1.6	19.4	<.5	<1
July 30-Aug. 5	E6	170	5	165	2.9	19.6	1.1	<1
Aug. 6-12	E29	140	8	132	1.3	20.0	0.6	3
Aug. 20-26	E30	155	<5	150	1.3	20.2	0.4	2
Aug. 20-26	E33	145	<5	140	1.4	20.0	0.4	2

Table G13. Ethyl Corporation Final Effluent , 1980

Date	Sample Number	Solids (mg/L)			Carbon (mg/L)			Phenols (ug/L)	Pb (mg/L)
		Total	Sus.	Dis.	DOC	DIC	PTC		
July 16-22	E3	1200	25	1010	3.9	18.6	1.9	4	-
July 23-29	E4	35	<5	30	2.0	19.6	0.8	2	-
July 30-Aug. 5	E5	1155	65	1090	1.7	17.2	3.7	8	-
Aug. 6-12	E31	905	25	880	1.8	17.0	-	2	.49
Aug. 13-19	E32	1125	20	1110	13.1	23.2	-	4	.64
Aug. 20-26	E34	965	9	955	2.2	22.0	-	2	.33

Table G14. Ethyl Corp. Service Water , 1980.

Date	Type of Sample (1)	Phenols (ug/L)	Solids (mg/L)			Carbon (mg/L)			Cond. (uS/cm)	pH	Pb (mg/L)
			Total	Sus.	Dis.	DOC	DIC	PTC			
July 16	C	2	179	3	176	1.7	20.2	-	250	7.6	<.003
July 17	C	<1	167	1	166	2.0	19.8	-	280	7.8	<.003
July 18	C	<1	170	1	169	2.2	19.6	-	-	-	<.003
July 19	C	1	188	12	176	1.6	19.2	-	270	7.8	-
July 20	C	1	179	7	172	1.7	19.2	-	270	7.8	<.003
July 21	C	<1	172	3	169	1.5	19.4	-	275	8.0	<.003
July 22	C	1	174	5	169	1.6	18.8	-	-	-	<.003
July 23	C	2	194	2	192	1.6	19.0	-	270	7.9	<.003
July 24	C	1	183	1	182	1.7	19.6	-	330	8.1	<.003
July 25	C	<1	178	2	176	1.7	19.2	-	-	-	<.003
July 26	C	3	192	3	189	1.6	20.0	-	320	7.9	<.003
July 27	C	3	175	3	172	1.6	20.0	-	290	7.7	<.003
July 28	C	2	169	3	166	1.6	19.8	-	330	7.8	<.003
July 29	C	<1	178	2	176	1.6	20.0	-	310	7.6	<.003
July 30	C	<1	169	3	166	1.6	19.2	-	230	7.8	<.003
July 31	C	<1	-	5	-	1.8	19.6	<.5	240	7.5	<.003
Aug. 1	C	<1	-	2	-	1.8	19.4	<.5	250	8.0	<.003
Aug. 2	C	<1	-	2	-	1.8	19.6	<.5	280	8.0	<.003
Aug. 3	C	<1	-	7	-	2.0	18.8	<.5	270	8.2	<.003
Aug. 4	G	1	-	4	-	2.0	19.2	<.5	250	8.3	<.003
Aug. 5	G	<1	-	7	-	2.0	19.4	<.5	245	8.4	<.003
Aug. 6	G	<1	-	10	-	1.9	19.0	0.5	240	8.4	<.003
Aug. 7	C	-	-	40	-	1.7	19.0	2.2	-	-	<.003
Aug. 8	C	-	-	8	-	1.7	19.2	0.6	305	7.7	<.001
Aug. 9	C	-	-	45	-	2.3	19.6	0.3	295	8.0	<.003
Aug. 10	C	-	-	<5	-	1.8	19.6	0.2	245	7.8	<.003
Aug. 11	C	1	-	<5	-	1.9	18.6	0.5	250	7.9	<.003
Aug. 12	C	1	-	<5	-	2.1	19.8	0.6	240	8.0	<.003
Aug. 13	C	<1	-	<5	165	1.7	18.8	<.2	255	7.9	<.003
Aug. 14	C	1	175	<5	170	1.8	18.8	0.3	255	8.1	<.003
Aug. 15	G	<1	155	<5	150	1.6	18.8	<.2	240	8.4	<.003
Aug. 16	C	-	155	5	150	1.9	19.2	0.4	235	8.6	<.005
Aug. 17	G	9	160	9	169	1.5	19.4	0.6	255	8.1	<.005
Aug. 18	C	8	170	14	156	1.6	19.4	0.8	260	7.7	<.005
Aug. 19	C	8	155	<5	150	1.7	19.6	<.4	235	8.0	<.005
Aug. 20	C	8	155	<5	150	1.8	19.6	<.4	220	8.3	<.005
Aug. 21	C	6	155	11	-	1.6	19.2	<.4	260	8.4	<.005
Aug. 22	C	7	155	6	149	1.7	19.2	0.8	240	8.1	<.005
Aug. 23	C	<1	130	<5	125	2.0	19.6	<.4	225	8.1	<.003
Aug. 24	C	<1	125	<5	-	2.0	19.8	<.4	220	8.1	<.003
Aug. 25	C	<1	120	<5	-	2.0	19.6	<.4	225	8.5	<.003
Aug. 26	C	<1	120	<5	-	2.0	19.6	<.4	230	8.0	<.003

1 C = 24h continuous composite
G = grab sample

Table G15. Ethyl Corp. Final Effluent , 1980.

Date	Type of Sample (1)	Phenols (ug/L)	Solids (mg/L)			Carbon (mg/L)			Cond. (uS/cm)	pH	Pb (mg/L)
			Total	Sus.	Dis.	DOC	DIC	PTC			
July 16	C	1	1105	14	1091	18.3	20.8	-	2750	7.2	.68
July 17	G	9	562	3	559	2.6	18.2	-	2750	8.2	.22
July 18	C	12	968	6	962	1.5	20.6	-	-	-	.74
July 19	C	4	652	8	644	1.4	19.8	-	2145	7.7	1.2
July 20	C	37	1103	17	1086	1.4	25.0	-	2025	8.4	1.5
July 21	C	17	1120	12	1108	1.1	27.2	-	2200	8.9	.65
July 22	C	10	1086	25	1061	1.2	18.0	-	-	-	-
July 23	G	-	-	-	-	-	-	-	2750	8.0	.034
July 24	C	1	184	2	182	1.8	19.8	-	-	-	.024
July 25	C	<1	-	-	-	-	-	-	2750	7.8	.015
July 26	C	1	187	2	185	1.6	19.2	-	-	-	.020
July 27	C	<1	178	2	176	1.7	20.0	-	-	-	.010
July 28	C	<1	179	7	172	1.6	20.0	-	250	7.8	.020
July 29	C	16	653	5	648	1.5	19.6	-	1155	7.8	.31
July 30	C	16	1228	41	1187	1.3	19.0	-	2200	7.9	1.7
July 31	C	21	-	65	-	1.8	16.2	3.3	1100	8.1	2.0
Aug. 1	C	41	-	70	-	0.9	14.2	4.4	-	-	1.9
Aug. 2	C	2	-	12	-	1.3	19.6	0.9	2300	8.2	.80
Aug. 3	G	2	-	9	-	1.3	20.0	0.7	2550	8.1	.30
Aug. 4	G	13	-	8	-	1.0	19.8	1.7	2300	8.0	1.3
Aug. 5	G	12	-	265	-	4.9	2.8	3.0	-	-	4.4
Aug. 6	G	31	-	40	-	1.0	15.2	4.6	2200	8.0	.58
Aug. 7	C	-	-	20	-	4.8	18.0	1.1	-	-	.88
Aug. 8	C	-	-	35	-	1.4	17.6	2.0	1950	8.3	.001
Aug. 9	C	-	-	<5	-	1.6	14.0	3.3	1750	10.2	1.0
Aug. 10	-	-	-	-	-	-	-	-	-	-	-
Aug. 11	G	12	-	85	-	2.4	12.8	9.0	1375	9.9	.34
Aug. 12	G	41	-	20	-	2.0	15.0	1.4	1550	9.4	.37
Aug. 13	C	22	-	<5	-	2.2	18.8	2.7	1800	7.7	.39
Aug. 14	C	50	-	40	-	2.5	12.2	1.4	2150	10.4	.91
Aug. 15	C	24	-	<5	-	25.0	21.0	1.4	1660	8.0	1.2
Aug. 16	C	38	-	15	-	56.5	20.4	1.4	1850	8.9	.039
Aug. 17	C	32	1170	20	1150	1.8	20.0	1.3	1950	8.25	.041
Aug. 18	C	32	1080	45	1035	75.0	19.6	2.9	1950	8.2	.069
Aug. 19	C	45	1380	25	1355	15.4	18.0	3.3	1850	8.7	.012
Aug. 20	C	-	1280	13	1267	10.5	20.8	1.3	1120	8.1	.044
Aug. 21	G	11	700	13	687	1.7	21.2	1.3	1650	8.1	.10
Aug. 22	C	26	1120	<5	1115	1.2	21.6	0.4	1900	8.2	.029
Aug. 23	C	12	1180	6	1174	1.6	20.8	0.7	1720	8.3	.81
Aug. 24	C	65	1080	<5	1075	1.4	22.4	0.5	1550	7.9	.47
Aug. 25	C	7	1380	20	1360	1.4	20.2	1.7	2050	8.1	.93
Aug. 26	C	50	1330	230	1100	0.8	21.2	14.6	3450	8.6	.63

1 C = 24h continuous composite
G = grab sample

Table G16. Petrosar Intake , 1980.

Date	Solids (mg/L)			Carbon (mg/L)			Cond. (uS/cm)	pH	Phenols (ug/L)
	Total	Sus.	Dis.	DOC	DIC	PTC			
Sept. 6	165	<5	160	1.6	19.2	<.4	1700	8.0	1
Sept. 9	150	<5	145	1.5	19.4	<5.0	210	8.4	<1
Sept. 13	145	<5	140	1.7	19.8	0.6	220	8.4	7

Table G17. Petrosar Chemical DAF , 1980.

Date	Solids (mg/L)			Carbon (mg/L)			Cond. (uS/cm)	pH	Phenols (ug/L)
	Total	Sus.	Dis.	DOC	DIC	PTC			
Sept. 6	5620	80	5540	92.2	33.6	7.7	4850	6.9	8500
Sept. 7	6110	35	6070	92.2	19.6	7.4	7000	6.8	16500
Sept. 8	6640	40	6590	177.0	25.8	12.3	8200	7.0	12500
Sept. 9	5880	50	5830	180.0	21.4	13.7	6900	6.9	14000
Sept. 10	4670	35	4640	94.1	23.4	22.4	6000	6.9	19000
Sept. 11	5900	65	5830	70.0	25.0	18.0	7000	7.5	14000
Sept. 12	7470	85	7380	78.0	37.2	7.7	8000	6.8	13000
Sept. 13	7140	65	7080	72.0	26.6	12.0	7800	5.7	12000
Sept. 14	5240	70	5170	98.0	27.6	10.0	6200	7.4	14000

Table G18. Petrosar Oily DAF , 1980.

Date	Solids (mg/L)			Carbon (mg/L)			Cond. (uS/cm)	pH	Phenols (ug/L)
	Total	Sus.	Dis.	DOC	DIC	PTC			
Sept. 6	1120	20	1100	14.8	20.6	9.8	1125	7.0	700
Sept. 7	1170	20	1150	13.7	21.6	9.6	1700	7.2	675
Sept. 8	1150	20	1130	12.2	22.8	7.6	1650	7.0	2800
Sept. 9	1270	15	1250	13.0	23.4	10.7	1700	7.3	750
Sept. 10	1280	6	1270	14.5	21.8	11.0	1700	7.1	850
Sept. 11	1220	15	1210	14.5	26.4	2.9	1650	8.0	875
Sept. 12	1170	14	1150	14.5	26.4	4.2	1485	7.1	1300
Sept. 13	1190	20	1170	52.5	23.2	7.3	1485	7.5	1100
Sept. 14	125	6	120	1.6	19.2	0.8	970	7.8	2500

Table G19. Petrosar Biox Unit , 1980.

Date	Solids (mg/L)			Carbon (mg/L)			Cond (uS/cm)	pH	Phenols (ug/L)
	Total	Sus.	Dis.	DOC	DIC	PTC			
Sept. 6	4730	30	4700	30.0	15.0	9.9	4450	6.9	175
Sept. 7	5040	35	5010	29.0	15.0	7.7	5800	7.7	100
Sept. 8	5170	25	5140	72.0	15.6	11.6	6700	6.9	125
Sept. 9	5020	20	5000	93.0	15.6	8.7	6000	7.2	750
Sept. 10	4250	25	4220	72.0	13.8	10.1	5200	6.8	250
Sept. 11	4120	25	4090	46.5	14.8	9.1	4800	7.8	550
Sept. 12	4940	20	4920	45.0	20.6	5.3	5800	7.2	900
Sept. 13	5690	35	5650	42.0	16.6	5.9	6200	7.4	1025
Sept. 14	4890	25	4860	69.5	15.8	4.4	5800	7.5	525

Table G20. Petrosar A/C Filter , 1980.

Date	Solids (mg/L)			Carbon (mg/L)			Cond. (uS/cm)	pH	Phenols (ug/L)
	Total	Sus.	Dis.	DOC	DIC	PTC			
Sept. 6	1040	7	1033	5.1	24.0	2.8	1240	7.2	240
Sept. 7	1170	7	1163	3.6	26.6	2.8	1450	7.3	300
Sept. 8	1120	9	1111	2.8	24.4	2.6	2000	7.4	525
Sept. 9	1260	12	1248	2.8	25.0	2.9	1750	7.3	300
Sept. 10	1250	12	1238	1.9	28.2	3.6	1700	7.2	900
Sept. 11	1240	<5	1235	2.3	20.8	2.3	1540	7.9	325
Sept. 12	1120	8	1120	2.9	24.6	2.5	1560	7.1	250
Sept. 13	1150	7	1140	2.4	25.2	2.3	1400	7.3	700
Sept. 14	720	<5	715	56.5	18.4	0.6	955	7.2	375

Table G21. Petrosar Final , 1980.

Date	Solids (mg/L)			Carbon (mg/L)			Cond. (uS/cm)	pH	Phenols (ug/L)
	Total	Sus.	Dis.	DOC	DIC	PTC			
Sept. 6	1300	7	1293	9.1	16.8	2.2	1240	7.1	16
Sept. 7	1530	13	1527	9.8	13.8	2.9	2000	6.8	40
Sept. 9	2250	20	2230	28.5	20.8	5.7	2700	7.4	425
Sept. 11	1230	13	1220	9.3	10.2	2.4	1460	7.5	35
Sept. 14	1160	9	1150	18.0	21.2	2.0	1500	7.3	180

APPENDIX H

BIOASSAY TEST DATA

TABLE H1: Summary of Bioassay Results for samples collected during 1979 in the Sarnia District.

Company	Sample Site	Date Sampled	Date Tested	Sample No.	96 hr. LC50
C.I.L.	Final	26/07/79	26/07/79	79-23	N.L.[1]
Dow	Scott Rd.Dump	26/07/79	26/07/79	79-21	N.L.
Dow	54" Sluice	20/06/79	21/06/79	79-1	N.L.
Dow	54" Sluice	18/07/79	19/07/79	79-11	100%
Dow	54" Sluice	15/08/79	16/08/79	79-32	N.L.[1]
Dow	3rd St. Sewer	20/06/79	21/06/79	79-3	N.L.
Dow	3rd St. Sewer	18/07/79	19/07/79	79-13	88%
Dow	3rd St. Sewer	15/08/79	16/08/79	79-34	>100%
Dow	Acid Tile Drain	20/06/79	21/06/79	79-2	11%
Dow	Acid Tile Drain[2]	20/06/79	21/06/79	79-2	86%
Dow	Acid Tile Drain	18/07/79	19/07/79	79-12	>100%
Dow	Acid Tile Drain	15/08/79	16/08/79	79-33	32%
Dow	Acid Tile Drain[2]	10/08/79	16/08/79	79-33	N.L.
Dupont	Final	24/07/79	24/07/79	79-15	N.L.
Ethyl	Final	25/10/79	25/10/79	79-162	N.L.
Ethyl	Final	31/07/79	31/07/79	79-25	23
Holmes	Final	26/07/79	26/07/79	79-22	N.L.
Esso	Final	25/07/79	25/07/79	79-16	N.L.
Esso	Final	02/08/79	02/08/79	79-31	>100%
IOEL	Tank Farm Drain.	26/07/79	26/07/79	79-19	N.L.
IOEL	Cooling H_2O	26/05/79	31/05/79	79-27	N.L.
IOEL	Bi-ox Plant	29/05/79	31/05/79	79-26	N.L.
IOEL	Service H_2O	29/05/79	31/05/79	79-25	N.L.
Petrosar	Final	31/07/79	31/07/79	79-24	N.L.
Polysar	66" Sewer	01/08/79	01/08/79	79-26	N.L.
Polysar	Ditch Out	16/08/79	16/08/79	79-37	N.L.
Polysar	Ditch In	16/08/79	16/08/79	79-36	N.L.
Polysar	Ditch Out	01/08/79	01/08/79	79-28	N.L.
Township	Ditch In	01/08/79	01/08/79	79-27	N.L.
Polysar	Ditch Out	27/06/79	27/06/79	79-7	N.L.
Polysar	Ditch In	27/06/79	27/06/79	79-6	N.L.
Polysar	Stereo API	16/08/79	16/08/79	79-38	41%
Polysar	66"Sewer	16/08/79	16/08/79	79-35	N.L.
Polysar	Stereo API	01/08/79	01/08/79	79-30	30%
Polysar	Stereo API	27/06/79	27/06/79	79-4	28%
Polysar	Styrene II	16/08/79	16/08/79	79-39	2.3%
Polysar	66" Sewer	27/06/79	27/06/79	79-5	N.L.
Shell	Final	29/05/79	31/05/79	79-22	N.L.
Shell	Service H_2O	29/05/79	31/05/79	79-27	N.L.
Shell	Cooling H_2O	29/05/79	29/05/79	79-20	N.L.
Shell	Final-Pond	11/06/79	11/06/79	79-46	N.L.
Sun	Service H_2O	29/05/79	31/05/79	79-24	N.L.
Sun	Final	29/05/79	31/05/79	79-22	N.L.
Twn. Ditch	Railway Track	26/07/79	26/07/79	79-17	N.L.
Scott Rd.	Township Ditch	01/08/79	01/08/79	79-29	N.L.
Scott Rd.	Township Ditch	26/07/79	26/07/79	79-20	N.L.
Scott Rd.	Township Ditch	29/07/79	19/07/79	79-14	>100%
Scott Rd.	Township Ditch	27/06/79	27/06/79	79-8	65%

[1]N.L. = not lethal
[2]pH of sample was adjusted to 7.0 before bioassay conducted.

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5664